

MISSION REQUIREMENTS

SECOND SKYLAB MISSION
SL-3

June 1, 1973

SKYLAB PROGRAM OFFICES
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
JOHNSON SPACE CENTER
AND
MARSHALL SPACE FLIGHT CENTER

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FLAG SHEET
MISSION REQUIREMENTS DOCUMENT
SL-3

The purpose of the flag sheet is to identify portions of the Mission Requirements Document (MRD) which are affected by either approved changes or changes pending approval.

- A. The format of all medical and corollary experiments has been updated. This format change was made as a result of mission planning simulation experience and in coordination with appropriate elements of JSC and MSFC. The basic changes in the format are:
- 1) The functional objectives (FO's) of a large number of the experiments have been subdivided (increased) to aid status keeping.
 - 2) Requirements for performance of the experiments have been classified into three levels: Baseline Requirement, Minimum Scheduling Requirement, and Performance Redline.
 - 3) The Test Conditions section has been split into Performance Conditions and In-Flight Data sections.
 - 4) The Success Criteria section has been deleted.
- B. A complete Section 3.2.2 is provided for the ATM requirements.
- C. The following is a list of new DTO's appearing in this volume of the MRD for the first time.

Experiment DTO's

M110	Hematology and Immunology Series (Covers in-flight blood sampling for Experiments M112, M113, M114, and M115)
S150	Galactic X-Ray Mapping (B)
S230	Magnetospheric Particle Composition

Student Investigations

ED11	Atmospheric Absorption of Heat
ED12	Volcanic Study
ED21	Libration Clouds
ED22	Objects Within Mercury's Orbit
ED32	In Vitro Immunology
ED52	Web Formation
ED63	Cytoplasmic Streaming
ED74	Mass Measurement

Subsystem/Operational DTO's

20.11	Operational Radiation Measurements
20.14	Orbital Assembly Contamination Assessment
20.16	Water Sample
20.17	Iodine Monitoring
20.18	Carbon Monoxide Monitor
20.19	SLA Deployment Observation

- D. The DTO for Student Investigation ED25 (X-Rays From Jupiter) has not been included pending further definition and Level II CCB approval.
- E. The DTO's for experiments S020, X-Ray/Ultraviolet Solar Photography, and T025, Coronagraph Contamination Measurement, are excluded from this document due to the unavailability of the solar SAL for experiment operations. Requirements for use of the solar SAL by experiments S063, S149, and T027/S073 have been deleted. The following modifications are under consideration in lieu of solar SAL operations:
- Deployment of the S020 hardware during EVA on a bracket external to the spacecraft.
 - Deployment of the T025 hardware during EVA on a bracket external to the spacecraft.
 - Operation of S063 out the AM window.

In addition, consideration is being given to changing FO 2 of experiment S149 such that one set of Micrometeorite Impact Detection Cassettes will be deployed during one EVA and retrieved during another EVA.

New DTO's for S020 and/or T025 will be published, if approved by Level II CCB. Modified DTO's for S063 and/or S149 will be published, if approved by Level II CCB.

- F. Proposed changes are in work for the venting and dumping constraints contained in the DTO's for experiments S019, S063, S149 and S183. These changes will be identified in this document after Level II CCB approval.
- G. The inclusion of minimum scheduling requirements and performance red-lines into the experiment DTO's has been done with the understanding that these data are to be incorporated into NASA Headquarters Program Directive No. 43C (Reference 1).
- H. Headquarters has given verbal direction to include a second film cassette for experiments S019 and S183. These cassettes will be used for additional operation of these experiments as time is available.
- I. Z-LV(E) attitude requirements stated in paragraph 2.3.2.7 are based on nominal systems performance. These requirements are subject to change based on an evaluation of SL-1/SL-2 systems performance data.
- J. Reassignments of experiments M555 and S015 from the SL-1/SL-2 mission to the SL-3 mission are under consideration.
- K. Consideration is being given to the resupply of an emulsion package and the reassignment of experiment S009 to the SL-3 mission.

- L. Proposed changes are in work for the Skylab Video Documentation Project Requirements for Television. These changes will expand paragraph 2.3.8 and will completely replace Table 2-2, Summary of SL-3 Telecasts, if approved by Level II CCB.

DOCUMENT CHANGE RECORD

Document Title: Mission Requirements, Apollo Applications
Missions AAP-1/AAP-2, AAP-3 and AAP-4

Original Document No.: MSC-KM-D-68-1

Original Issue Date: June 14, 1968

Revision 1 January 1969 (No. changed to I-MRD-001)

Complete updating of the basic document and Appendix A as originally issued and incorporates Appendixes B and C. Changes from the basic document are flagged by a vertical bar in the right hand margin.

This document supersedes and replaces MSC-KM-D-68-1 dated June 14, 1968.

Revision 2 September 10, 1969 (No. changed to I-MRD-001A
and title corrected to reflect latest mission
designations)

Complete updating of the document to reflect the change from a Saturn I (wet) Workshop to a Saturn V (dry) Workshop.

This document supersedes and replaces I-MRD-001 dated January 1969.

Revision 3 March 1970 (No. changed to I-MRD-001B)

Complete updating of Revision 2 to reflect incorporation of 50° inclination and changes in experiments.

Change 1 to Revision 3 June 30, 1970

Change pages issued to correct critical out-of-date data in Revision 3.

Revision 4 November 2, 1970 (No. changed to I-MRD-001C)

Complete updating of Revision 3 to reflect incorporation of Detailed Test Objectives and program name change.

This document supersedes and replaces I-MRD-001B, Revision 3, dated March 1970.

Revision 5 April 30, 1971 (No. changed to I-MRD-001D)

Complete updating of Revision 4 to reflect incorporation of revised and new Detailed Test Objectives.

This document supersedes and replaces I-MRD-001C, Revision 4, dated November 2, 1970. Changes from Revision No. 4 are flagged by a vertical bar in the right hand margin. With this revision, the MRD has been separated into three volumes, one for each mission. Issue date for Volume I, First Skylab Mission (SL-1/SL-2), is as shown above, April 30, 1971. Issue date for Volume II, Second Skylab Mission (SL-3), is August 1, 1971. Issue date for Volume III, Third Skylab Mission (SL-4), is November 1, 1971.

DOCUMENT CHANGE RECORD (Continued)

Revision 6 February 1, 1972 (No. changed to 1-MRD-001E)

Complete updating of Volume II to incorporate changes in experiments, reflect changes in experiment assignments, and to delete data requirements section of Detailed Test Objectives. This document supercedes and replaces 1-MRD-001D, Volume II, dated 1 August 1971.

Change 1 to Revision E September 1, 1972

Changed to reflect revised requirements set forth in Program Directive 43B, dated March 27, 1972. Change 1 incorporates SCN'S 2, 4, 6, 7, 9, 11, 12, and 13.

Revision 7 June 1, 1973 (No. changed to I-MRD-001F)

Complete updating of Volume II to incorporate a new DTO format, student investigation DTO's, and several subsystem/operational DTO's. This revision incorporates all previous changes listed above and, in addition, incorporates the following approved changes:

CCBD 2X0223/800-72-0586 (SCN 14)	CCBD 2X1228/800-72-1431 (SCN 32)
CCBD 2X0307/800-72-0735 (SCN 15)	CCBD 2X1109/800-73-0073 (SCN 35)
CCBD 2X1110/800-72-1305 (SCN 19)	CCBD 3X0085/800-73-0189 (SCN 41)
CCBD 2X0882/800-72-1308 (SCN 21)	CCBD 3X0310/800-73-0292 (SCN 45)
CCBD 2X1146/800-72-1305 (SCN 22)	CCBD 3X0207/800-73-0319 (SCN 50)
CCBD 2X1301/800-72-1377 (SCN 24)	CCBD 3X0296/800-73-0309 (SCN 51)
CCBD 2X1016/800-72-1348 (SCN 27)	CCBD 3X0313/800-73-0325 (SCN 53)
CCBD 2X1094/800-72-1399 (SCN 28)	CCBD 2X1317/800-73-0039 (SCN 56)
CCBD 2X1015/800-72-1288 (SCN 29)	CCBD 3X0409/800-73-0414 (SCN 66)
CCBD 2X1018/800-72-1434 (SCN 30)	CCBD 3X0402/800-73-0406 (SCN 68)

This document supersedes and replaces I-MRD-001E, Volume II, dated February 1, 1972.

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NOMENCLATURE

°	
Å	Angstrom
AA	Aerosol Analyzer
ALSA	Astronaut Life Support Assembly
AM	Airlock Module, also Atmospheric Mode
AMRV	Astronaut Maneuvering Research Vehicle
AMS	Articulated Mirror System
AMU	Astronaut Maneuvering Unit
APCS	Attitude and Pointing Control System
A-SOL	Anti-Solar
ASP	Automatic Sample Processor
ATM	Apollo Telescope Mount
β	Minimum angle between the earth-sun line and the vehicle orbital plane. When viewing orbital plane from direction of sun, β is positive if apparent vehicle motion is counter-clockwise and negative if apparent vehicle motion is clockwise.
BE	Building Block
BDA	Bermuda Tracking Station
BMMD	Body Mass Measurement Device
C	Centigrade
C&D	Control and Display
CDS	Circadian Data System
CM	Command Module, also Contamination Mode
cm	Centimeter
CMG	Control Moment Gyro
COAS	Crewman Optical Alignment Sight
CONUS	Continental United States
CPD	Crew Passive Dosimeter
CS	Crew Station
CSM	Command and Service Module
DA	Deployment Assembly
DAC	Data Acquisition Camera

NOMENCLATURE (Continued)

DEG	Degree
DOD	Department of Defense
DRF	Data Request Form
DTO	Detailed Test Objective
EA	Experiment Assembly
ECS	Environmental Control System
EEG	Electroencephalographic
EOG	Electro-oculographic
EPS	Electron Proton Spectrometer
ERD	Experiment Requirements Document
EREP	Earth Resources Experiment Package
EUV	Extreme Ultraviolet
EVA	Extravehicular Activity
F	Fahrenheit
FAS	Fixed Airlock Shroud
FCMU	Foot Controlled Maneuvering Unit
FDAI	Flight Director Attitude Indicator
Fe	Iron
FLT	Flight
FM	F-Corona Mode
FMAD	Flight Missions Assignment Directive
FMR	Flight Mission Rules
FMSC	Film Magazine Stowage Container
FMU	Force Measuring Unit
FO	Functional Objective
FOMR	Flight Operations Management Room
FOV	Field-of-View
fps	Frames Per Second
FSP	Flight Scheduling Precedence
FSS	Fine Sun Sensor
FT	Feet
g	Gravity
GMT	Greenwich Mean Time
H	Hydrogen

NOMENCLATURE (Continued)

H α	Hydrogen Alpha
HATS	Houston Area Test Site
HAW	Hawaii Tracking Station
HCO	Harvard College Observatory
Hg	Mercury
HMMU	Hand Held Maneuvering Unit
HSS	Habitability Support System
IMC	Image Motion Control
IMSS	In-Flight Medical Support System
IMU	Inertial Measurement Unit
in	inch
IR	Infrared
IU	Instrument Unit
JOP	Joint Observing Program
JSC	Johnson Space Center
K	Kelvin
km	kilometer
KSC	Kennedy Space Center
LBNP	Lower Body Negative Pressure
lbs	pounds
LES	Launch Escape System
LIMS	Limb Motion Sensor
LMR	Launch Mission Rules
LSU	Life Support Umbilical
LV	Launch Vehicle
LVDC	Launch Vehicle Digital Computer
M	Number of CSM Orbits Required for Rendezvous
MCC-H	Mission Control Center, Houston
MDA	Multiple Docking Adapter
Mev	Million Electron Volts
ml	milliliter
MFCV	Modulating Flow Control Valve
mm	millimeter
MO	Major Objective

NOMENCLATURE (Continued)

MOR	Mission Operations Report
MRG	Mission Rules Guidelines
MRD	Mission Requirements Document
MS	Motion Sensitivity
MSC	Manned Spacecraft Center
MSFC	Marshall Space Flight Center
MSN	Mission
N/A	Not Applicable
NASA	National Aeronautics and Space Administration
NM	Nautical Mile
NOAA	National Oceanic and Atmospheric Administration
NRL	Naval Research Laboratory
OA	Orbital Assembly
OD	Operations Directive
OGI	Oculogyral Illusion
OMSF	Office of Manned Space Flight
OTG	Otolith Test Goggles
OWS	Orbital Workshop
PAD	Program Approval Document
PI	Principal Investigator
PRD	Personal Radiation Dosimeter
PS	Payload Shroud
psia	Pounds per Square Inch Absolute
PSS	Propellant Supply Subsystem
RCS	Reaction Control System
RF	Radio Frequency
RLC	Rotating Litter Chair
RSM	Radiation Survey Meter
SA	Spectrograph Assembly
SAA	South Atlantic Anomaly
SAL	Scientific Airlock
SI	Student Investigator
SIS	Speaker Intercom System

NOMENCLATURE (Continued)

SL	Skylab
SLPD	Skylab Program Directive
SL-R	Skylab Rescue
SM	Service Module
SMMD	Specimen Mass Measurement Device
SOL	Solar
SOP	Secondary Oxygen Pack
SPS	Service Propulsion System
STDN	Spaceflight Tracking and Data Network
STS	Structural Transition Section
SVDP	Skylab Video Documentation Project
SWS	Saturn Workshop
SXT	Sextant
T	Temperature
TACS	Thruster Attitude Control Subsystem
TBD	To be Determined
TBS	To be Supplied
TPI	Terminal Phase Initiation
TV	Television
UV	Ultraviolet
VABD	Van Allen Belt Dosimeter
VAN	Vanguard Tracking Ship
VCS	Ventilation Control Subsystem
VCG	Vectorcardiogram
W	West
WLC	White Light Coronagraph
WMC	Waste Management Compartment
WT	Water Tank
X-IOP/Z	Solar Inertial Attitude (See Note: 1, Page 2-4)
XUV	Extreme Ultraviolet

NOMENCLATURE (Continued)

Z-LV	Z-Local Vertical Attitude
Z-LV(E)	Earth Pointing Attitude (See Note: 2, Page 2-4)
Z-LV(R)	Rendezvous Pointing Attitude

DEFINITIONS

The following definitions apply to usage of the terms in this document.

- Mission Objectives. Mission objectives are the ends toward which efforts are directed for each mission. Mission objectives are specified by the OMSF.
- Experiments. Experiments are planned investigations which are conducted in flight during manned space missions, or which are essentially connected with the in-flight situation. These investigations, which are approved by the Manned Space Flight Experiments Board and assigned by the Headquarters Program Office/ML, are conducted to obtain research information which can contribute to the advancement of science and technology.
- Extravehicular Activity. Activity performed in space or on a celestial body by an astronaut external to the space vehicle.
- Intravehicular Activity. Activity with one or more of the adverse characteristics of EVA, because of reduced gravity and/or pressurized space suit, performed in space or on a celestial body by an astronaut internal to the space vehicle.
- Primary Mission. The primary mission is a planned mission that satisfies a prescribed set of objectives and requirements as defined by the Operations Directives.
- Detailed Test Objective. Scientific, engineering, medical or operational objectives which amplify mission objectives or detail a major development purpose or feature of the mission. The accomplishment of a Detailed Test Objective will be an important consideration in determining the degree of achievement of the mission objective(s).

1.0 INTRODUCTION

1.1 BACKGROUND

The Skylab (SL) Program objectives are to extend the duration of manned space flight and to carry out a broad spectrum of experimental investigations. Of particular importance are a series of medical experiments associated with the extension of manned space flight, a series of high resolution solar astronomy experiments at the short wavelengths not directly observable from the surface of the earth and a series of earth survey experiments.

The Skylab missions are designed to support these objectives. Currently, the program includes three low earth orbit missions, designated SL-1/SL-2, SL-3 and SL-4. In addition to the three nominal Skylab missions, the program includes the Skylab Rescue Mission (SL-R). The SL-R mission is designed to provide a safe return of the Skylab crew in the event the Command and Service Module (CSM) becomes disabled while docked to the Saturn Workshop (SWS). This volume contains mission requirements for the second Skylab Mission (SL-3) only. The Skylab SL-1/SL-2, SL-4, and SL-R mission requirements are contained in Volumes I, III, and IV, respectively, of the Mission Requirements Document (MRD). Summaries of the Data Request Forms (DRF's) associated with Skylab Detailed Test Objectives are contained in Appendix A of the MRD. Earth resources requirements for the SL-1/SL-2, SL-3, and SL-4 missions are contained in Appendix B to the MRD.

The SL-3 mission will utilize an orbiting SWS. The SWS configuration includes a Multiple Docking Adapter (MDA), Apollo Telescope Mount (ATM), Airlock Module (AM), and an S-IVB Stage (modified as an Orbital Workshop [OWS]), previously launched and inserted into orbit on a two-stage Saturn V Launch Vehicle for the SL-1/SL-2 mission. The SL-3 configuration will be a manned CSM launched on a Saturn IB Launch Vehicle. The SL-3 CSM will rendezvous and dock with the SWS forming an Orbital Assembly (OA) to accomplish a long duration mission of up to 56 days.

1.2 SCOPE AND PRECEDENCE

The MRD is prepared in accordance with NASA Headquarters, Office of Manned Space Flight (OMSF) directives and Skylab specification documents as listed in NASA Headquarters Program Directive No. 43C, M-D ML3200.125, dated May 1, 1973 and Cluster Requirements Specification No. RS003M00003, dated August 8, 1969, References 1 and 2 respectively. It defines the mission requirements and the functional and performance requirements for implementing the program and mission objectives specified therein. The Mission Assignments and Flight Scheduling Precedence Numbers for the experiments were assigned by OMSF, NASA Headquarters Program Directive No. 43C, Reference 1. The scope of this document is the definition of mission operational requirements for the SL-3 mission.

The MRD shall provide the basis for mission planning and design by all elements of the Skylab Program. In the event of conflict between the MRD and other mission planning documentation, the MRD shall govern with respect to mission objectives and requirements.

The relationship of the MRD with other program documentation is depicted in Figure 1-1, Skylab Mission Documentation. Performance and design requirements for cluster systems to implement mission requirements are contained in the Cluster Requirements Specification (Reference 2).

Many subsidiary mission documents must be prepared to implement the requirements of this MRD. These documents may expand on, but must not conflict with the contents of the MRD.

1.3 PUBLICATION AND REVISIONS

1.3.1 Publication

Development of the MRD is the joint responsibility of the Skylab Program Offices at the Johnson Space Center (JSC) and the Marshall Space Flight Center (MSFC). Preparation and coordination of this document will be performed under the cognizance of the Mission Requirements Panel with approval and sign-off by both program managers.

1.3.2 Revisions

The document will be revised as required to provide necessary guidelines for supporting activities. All revisions will be handled in the same manner as the basic document and will require joint sign-off by the Skylab Program managers at both the JSC and MSFC.

Requests for changes to the document shall be submitted to either of the Co-chairmen, Mission Requirements Subpanel (P. H. Allen, JSC/KM; R. A. Marmann, MSFC/SL-EI).

1.3.3 Distribution

Distribution of this document is controlled by the Skylab Program Offices at JSC and MSFC. Requests for additions, deletions, or other changes to the distribution list should be forwarded to respective personnel as stated in Paragraph 1.3.2 above. Requests for additions by NASA personnel should be coordinated through their Division (or equivalent) office.

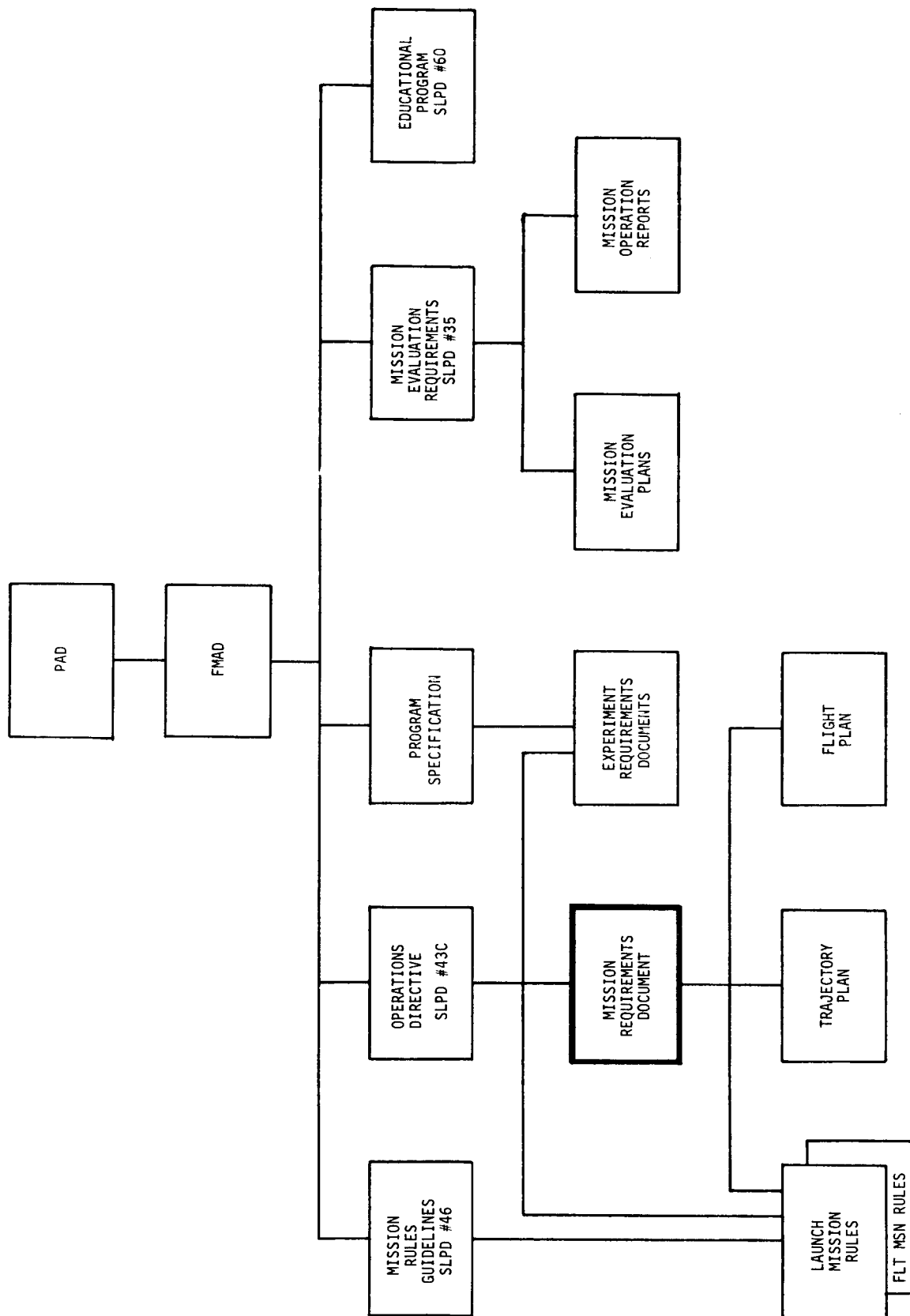


Figure 1-1. Skylab Mission Documentation

2.0 SKYLAB MISSION SL-3

2.1 MISSION DEFINITION

Skylab Mission SL-3 will be the second in a series of missions which are designed to achieve long duration space flights of men and systems and to perform scientific investigations in earth orbit. The Skylab mission phases and major events are illustrated in Figure 2-1. The SL-3 mission will consist of one manned CSM launch, rendezvous and docking with the orbiting SWS, and operation of both modules as an OA for up to 56 days to accomplish the mission objectives. The SWS will then be prepared for unmanned operations and the CSM will deorbit for recovery.

The unmanned phase of Skylab Mission SL-3 will begin when the SL-2 CSM and crew separate from the SWS just prior to reentry. The unmanned portion of the mission will continue until the SL-3 CSM and crew are launched to rendezvous and dock with the SWS. The manned phase of Skylab Mission SL-3 will terminate with recovery of the SL-3 CM and crew. Unmanned SWS operations after separation of the SL-3 CSM will be included as part of the SL-4 mission.

2.2 MISSION OBJECTIVES

The objectives for the SL-3 mission, as assigned by the OMSF, NASA Headquarters Program Directive No. 43C (Reference 1), are as follows:

2.2.1 Perform Unmanned Saturn Workshop Operations

- a) Obtain data for evaluating the performance of the unmanned SWS.
- b) Obtain solar astronomy data by unmanned ATM observations.

2.2.2 Reactivate the Skylab Orbital Assembly in Earth Orbit

- a) Operate the orbital assembly (SWS plus CSM) as a habitable space structure for up to 56 days after the SL-3 launch.
- b) Obtain data for evaluating the performance of the orbital assembly.
- c) Obtain data for evaluating crew mobility and work capability in both intravehicular and extravehicular activity.

2.2.3 Obtain Medical Data on the Crew for Use in Extending the Duration of Manned Space Flights

- a) Obtain medical data for determining the effects on the crew which result from a space flight of up to 56 days of duration.
- b) Obtain medical data for determining if a subsequent Skylab mission of greater than 56 days duration is feasible and advisable.

2.2.4 Perform In-Flight Experiments

- a) Obtain ATM solar astronomy data for continuing and extending solar studies beyond the limits of earth-based observations.
- b) Obtain earth resources data for continuing and extending multisensor observation of the earth from the low earth orbit.
- c) Perform the assigned scientific, engineering, technology and DOD experiments.

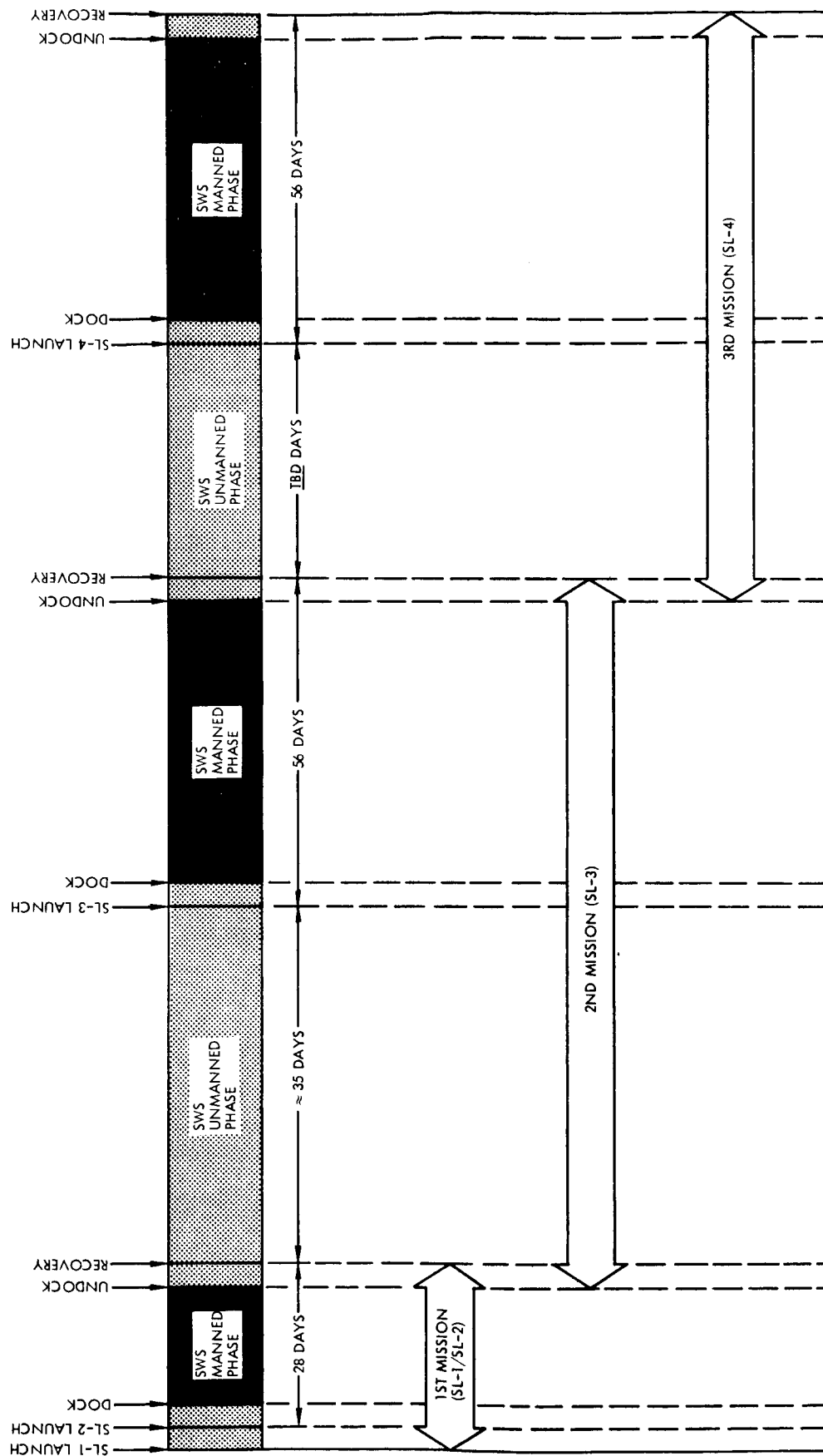


Figure 2-1. Skylab Mission Phases and Major Events

2.3 MISSION REQUIREMENTS

2.3.1 Mission Profile Requirements

2.3.1.1 Launch Date

Mission planning shall be based upon a launch readiness date for SL-3 within 64 (+1) days after the launch of SL-2 [i.e., July 28 (+1 day)].

2.3.1.2 Launch Planning

SL-3 shall not be launched until the SWS systems are judged to be operating in accordance with the criteria presented in the Flight Mission Rules.

Mission planning shall optimize selection of launch opportunities which will provide an "early rendezvous" (i.e., M = 5-8) capability and shall be based on a maximum of 700 pounds of SL-3 launch vehicle payload decrement for yaw steering. The basis for the "early rendezvous" requirement is the necessity for crew access to the SWS urine freezer within 24 hours of CSM launch to preserve urine samples.

2.3.1.3 Launch Complexes

SL-3 will be launched from Complex 39B at Kennedy Space Center (KSC).

2.3.1.4 Insertion Altitudes

The SWS will have been previously inserted into a near circular orbit of approximately 237 NM measured above the mean equatorial reference radius.

The SL-3 CSM will be inserted into an 81 by 120-NM orbit (measured above the mean equatorial reference radius) by a Saturn IB Launch Vehicle.

2.3.1.5 Orbital Inclination

Mission planning shall be based on a northerly launch azimuth.

The SL-3 CSM will be targeted for rendezvous with the SWS orbiting at a planned orbital inclination of 50 degrees.

2.3.1.6 Rendezvous and Docking

The SL-3 CSM will rendezvous with the SWS and will dock to the primary (axial) docking port. Launch time of day shall be optimized to obtain proper lighting in the recovery areas, provide early rendezvous for SL-3, obtain sufficient deorbit tracking coverage, and to provide (as much as possible) proper lighting and tracking coverage for abort situations. The CSM VHF ranging system will be required from a maximum distance of 300 NM to a minimum distance of 500 feet.

Operational planning shall insure that the SWS Attitude and Pointing Control System (APCS) gain changes from the unmanned configuration to the CSM docked configuration are implemented within one orbit after CSM docking. Gain changes required to reconfigure the APCS for the unmanned mode shall be made prior to CSM undocking.

2.3.1.7 S-IVB/IU Deorbit

The S-IVB/IU will be deorbited into the Pacific Ocean. The deorbit delta velocity will be provided by sequentially dumping liquid oxygen and liquid hydrogen through the S-IVB main engine. The deorbit maneuver will be designed to place the break-up debris footprint in the Pacific Ocean clear of major land masses.

2.3.1.8 Orbital Attitudes

The attitude requirements for the Saturn Workshop are as follows:

- a) Prior to CSM rendezvous - Solar inertial attitude (X-IOP/Z) (Note 1)
- b) CSM rendezvous - TBD
- c) CSM docking - X-IOP/Z
- d) Workshop operations - X-IOP/Z
- e) Earth pointing experiment operations - Earth pointing attitude (Z-LV[E]) (Note 2)
- f) Inertial Measurement Unit alignment - X-IOP/Z
- g) CSM undocking - Solar inertial attitude biased about the X and Z axes to place the XZ plane in the orbit plane.
- h) SWS storage - X-IOP/Z

2.3.1.9 Mission Duration

The SL-3 mission duration shall be planned for 56 days from the launch of the SL-3 CSM.

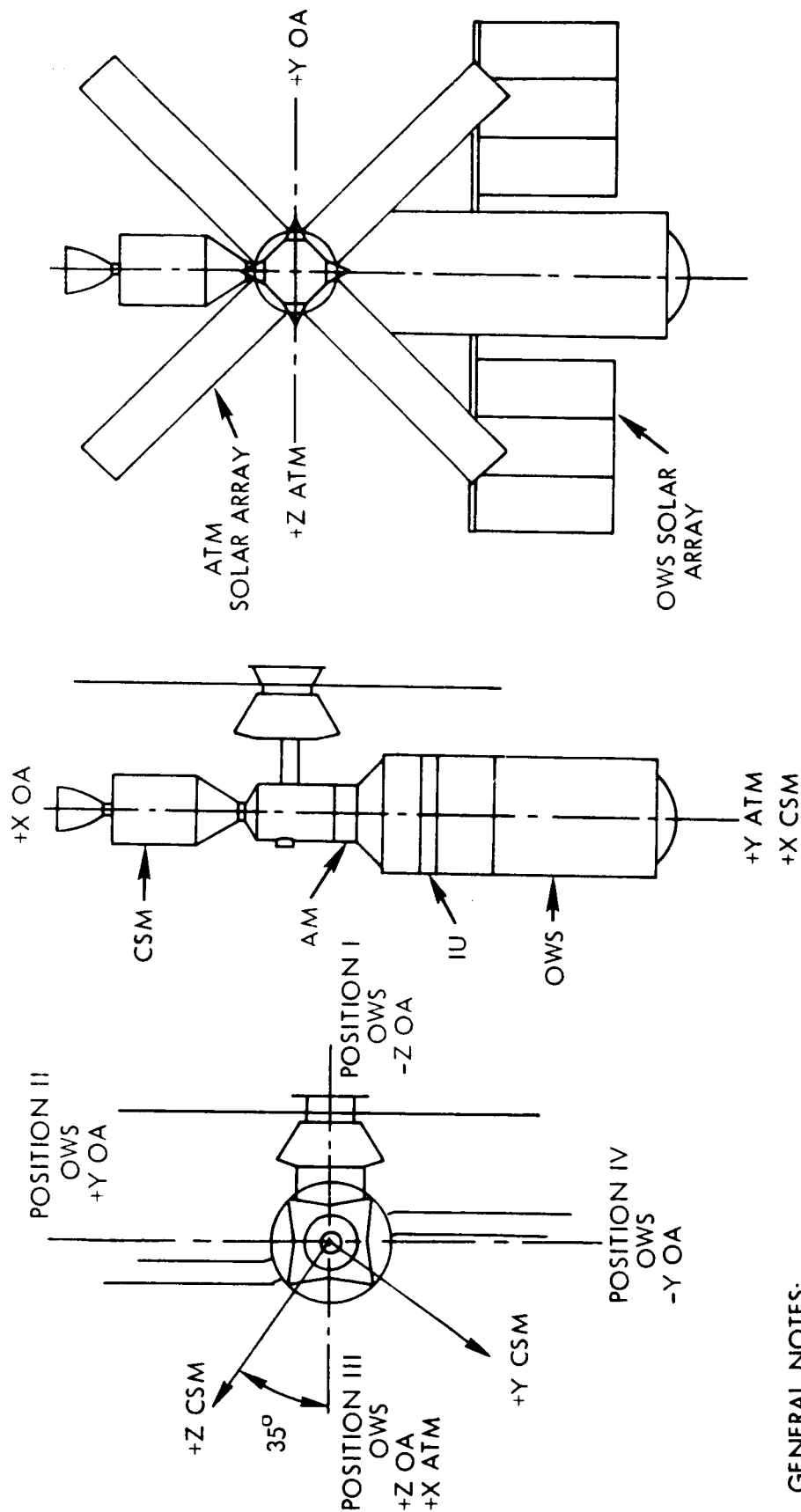
2.3.1.10 Recovery Zones

It is highly desirable that the mission be planned such that nominal recovery occurs during daylight. All planned landing areas shall be in water.

Notes:

1. X-IOP/Z: The solar inertial attitude is defined as the principal OA X axis in the orbital plane with the Z axis coincident with the sun line. The -Z axis points directly toward the sun and, at orbital noon, the +X axis is in the direction of the velocity vector. (The OA coordinate system is illustrated in Figure 2-2.) The X-IOP/Z mode includes Control Moment Gyro (CMG) desaturation maneuvers performed each orbit on the "night" side of the orbit.

2. Z-LV(E): The earth pointing attitude is defined as the OA geometric X axis in the orbital plane with the Z axis along the geodetic local vertical. The +Z axis points directly toward the earth and the +X axis is in the direction of the velocity vector (i.e., CSM leading).



- GENERAL NOTES:
- 1) THE MDA/AM/OWS AXES POLARITIES ARE THE SAME AS THOSE SHOWN FOR THE OA.
 - 2) THE OA Y AND Z AXES POLARITIES FOR DYNAMIC BODY AXES ARE THE REVERSE OF THOSE SHOWN.
 - 3) THE PURPOSE OF THIS SCHEMATIC IS TO ILLUSTRATE AXES SYSTEMS ONLY.

Figure 2-2. Skylab Orbital Assembly Configuration (Mass Properties Axes System)

2.3.2 Operations Requirements

2.3.2.1 Extravehicular Activity

Three extravehicular activity periods are planned for this mission. The EVA's shall be through the AM EVA hatch. The capability shall exist to perform EVA operations during both daylight and dark periods of the orbit. Each planned operation shall be limited to three hours of actual EVA time. Two crewmen shall be capable of EVA during the period.

2.3.2.2 Rendezvous Lighting

Flashing lights on the SWS shall be used during CSM rendezvous for: (a) acquisition and tracking with the Command Module (CM) sextant to update the CSM state vector prior to rendezvous maneuvers; and (b) tracking with the Crewman Optical Alignment Sight (COAS) prior to terminal phase initiation (TPI). The lights shall provide continuous coverage through the sextant for a maximum range of 300 NM during darkness.

2.3.2.3 CSM On-Orbit Verification

Periodic operation/monitoring of the CSM will be required to ensure a satisfactory deorbit capability.

2.3.2.4 Deorbit Capability

The SM Service Propulsion System (SPS) shall provide the primary deorbit capability for the SL-3 CSM. The SM RCS shall provide a backup deorbit capability. A hybrid deorbit capability (deorbit impulse provided partially by the SM RCS and partially by CM RCS) shall also be provided for use as specified in the Flight Mission Rules.

2.3.2.5 CMG Desaturation

The CMG desaturation will be automatic (with inhibit capability by the crew or Digital Command System command) and will occur during the "night" portion of the orbit (typically about 35 percent of the orbit is required for CMG desaturation).

2.3.2.6 Venting and Dumping

All controllable OA venting and dumping will be planned to occur such that it does not interfere with experiment and student investigation operations.

2.3.2.7 Orbital Assembly Attitude Control, Translation, and Experiment Pointing

Any OA attitude control maneuvers shall be performed using either the APCS or the RCS. The capability to translate the OA using SM RCS shall be provided. There shall be no maneuvering of the OA with the SPS.

For earth-pointing experiment operations, the SWS shall provide the capability to perform Z-LV(E) maneuvers. Pre-mission planning shall be based on the following guidelines which assume nominal systems performance:

- a) The Z-LV(E) attitude (as defined in paragraph 2.3.1.8, Note 2) for the data-take period may be maintained for up to 160 orbital degrees centered at any location within the orbit.

- b) The Z-LV(E) attitude maneuvers may be planned for Beta (β) angles up to ± 65 degrees.
- c) There shall be a maximum of two consecutive Z-LV(E) passes.
- d) No more than two Z-LV(E) passes per crew day for no more than two consecutive days shall be planned.
- e) Availability of electrical power, even under nominal conditions, may be limited for some Z-LV(E) maneuver profiles. Therefore, planning shall include exercising power management as required to stay within EPS capabilities and battery discharge constraints.

Real-time mission planning of Z-LV(E) maneuvers shall be based on actual systems performance which may dictate changes in these guidelines.

The total series of EREP operations will consist of a combination of Z-LV(E) maneuvers and solar-inertial operations as specified in Section 2.3.4.2.6.

2.3.2.8 OA Internal Activities

Nominal mission planning shall provide for a shirtsleeve environment for initial crew entry into the MDA and for subsequent normal everyday activities. Provisions and facilities shall be available to support an initial contingency suited entry by one crewman from the CSM into the MDA, and one or two crewmen from the MDA/AM into the OWS.

There shall be no requirement that a particular module of the OA be occupied at all times; however, immediately prior to and during EVA's the non-EVA crewman shall be on the CSM side of the AM lock compartment.

2.3.2.9 ATM Film Stowage

To assure return of ATM film in the event of an abort, the ATM film shall be stowed in the CM as soon as possible following EVA.

2.3.2.10 Budgeting of Electrical Power

Planning shall provide for operation of the CSM fuel cells until cryogenic depletion.

2.3.2.11 Orbit Trim Maneuvers

CSM RCS and SWS APCS shall be used to perform orbit trim maneuvers for the purpose of providing controlled repeating orbits for Earth Resources Experiments. The method utilized, where practicable, shall be selected to minimize contamination to the OA.

2.3.2.12 CSM Fly-Around Requirements

During the daylight pass following undocking, the CSM will perform a series of maneuvers to fly around the OWS at a range of 300 feet. The OWS will be visually inspected by the crew and 70-mm still photographs and 16-mm motion pictures will be obtained. TV coverage during fly-around will be as specified in paragraph 2.3.3(e). The OA attitude shall be as specified in paragraph 2.3.1.8(g).

2.3.3 In-Flight Operations

The following requirements and instructions, as specified in Program Directive No. 43C, shall be used in developing the SL-3 mission flight plans:

- a) Approximately one of every seven mission-days shall be scheduled as an off-duty day.
- b) Each off-duty day shall include performance of experiments M071 and M073, crew rest and recreation, nominal monitoring of spacecraft systems, and crew planning.
- c) Scheduling of crew activities shall permit rapid crew response to solar flares that may occur when the ATM console is not manned.
- d) To preserve urine samples, the SL-3 crew shall have access to the activated SWS urine freezer within 24 hours of CSM launch. In any event, all feces and samples of all urine voided after SL-3 life-off shall be processed in the SWS Waste Management System as soon as it becomes available for use.
- e) Skylab Video Documentation Project television requirements are identified in paragraph 2.3.8. ATM downlink television requirements are identified in paragraph 3.2.2.2(c).
- *f) A period averaging 30 minutes per day shall be set aside for each crewman for personal exercise. No exercise shall be performed by any of the crew on EVA days or by the subjects of experiments M171 and M509 on the days those experiments are performed. Exercise shall not be performed immediately following any kind of strenuous physical activity.

*This requirement is not specified in Program Directive No. 43C.

2.3.4 Experiments, Student Investigations, and Subsystems/Operational Tests

This section contains definitions, requirements, and instructions for scheduling in-flight experiments and subsystem/operational tests in the mission flight plan. Mission assignments and complementary scheduling requirements derived from Program Directive No. 43C (Reference 1) are given in Table 3-1.

2.3.4.1 Definitions of Mission Requirements Categories

The mission requirements are divided into the categories of experiments, student investigations, and subsystems/operational tests. These categories are briefly defined in the following paragraphs.

2.3.4.1.1 Experiments Definitions

The category of experiments is further divided into the sub-categories of (a) group-related experiments and (b) corollary experiments.

- a) Group-Related Experiments - The group-related experiments consist of three experiment groups, in-flight medical, ATM, and EREP. The experiments were grouped in this manner because all of the experiments in a given group have a common purpose and in the case of ATM and EREP they can be scheduled and performed as a group. The objectives of each experiment group are as follows:
 - 1) In-flight medical* - Determine and evaluate man's physiological responses and aptitudes in space under zero gravity conditions.
 - 2) ATM - Study short wavelength solar radiation (0.1 through 7000 angstroms) not readily observable from the surface of the earth due to atmospheric interference.
 - 3) EREP - Provide photographic and electronic remote sensor data for use by a variety of users in a wide range of applications to earth resources management.
- b) Corollary Experiments - The corollary experiments are those in-flight experiments other than the group-related experiments and the student investigations. These experiments have been assigned a Flight Scheduling Precedence (FSP) number for use in flight planning. The FSP number is assigned by Headquarters in accordance with the scientific worth of the experiment to the Skylab Program with the most valuable corollary experiment having the highest FSP. The FSP numbers range between 500 and 140.

There are in the corollary experiment group some experiments which have not been assigned to this mission but at the discretion of the JSC and MSFC Skylab Program Offices may be performed if time is available. These are called candidate experiments. If available time is unusable for assigned experiments but is usable for a candidate experiment, that experiment may be

* Although M151 (Time and Motion Study) is part of the in-flight medical group, it has been assigned a FSP and does not have the schedule priority of the in-flight medical group.

scheduled provided the requirements set forth in Table 3-1 will not have been satisfied on mission SL-1/SL-2. As assigned experiments achieve their baseline requirements, experiments assigned to candidate status on SL-3 will be scheduled. Candidate experiments will be considered for implementation in order of decreasing FSP.

2.3.4.1.2 Student Investigations

A number of investigations selected from a national contest of the Skylab Student Project will be performed aboard the orbital assembly. Several of these investigations have been assigned to the SL-3 mission.

There are in the student investigation group some investigations which have not been assigned to this mission but at the discretion of the JSC and MSFC Program Offices may be performed if time is available. These are called candidate investigations. If available time is unusable for assigned experiments or for assigned student investigations but is usable for a candidate investigation, that investigation may be scheduled provided the requirements set forth in Table 3-1 will not have been satisfied on mission SL-1/SL-2. As assigned experiments and assigned student investigations achieve their baseline requirements, investigations assigned to candidate status on SL-3 will be scheduled. All candidate experiments take precedence over candidate investigations.

2.3.4.1.3 Subsystems/Operational Tests

Subsystems/operational tests are activities designed to provide data for real-time and/or postflight evaluation of subsystems operation or for real-time mission operations planning.

Subsystems/operational tests for mission SL-3 will be approved at Level II and subsequently documented as Detailed Test Objectives (DTO's) in the Mission Requirements Document (MRD). Each DTO shall clearly indicate whether the test is (1) mandatory with respect to crew safety or mission objectives or (2) non-mandatory.

2.3.4.2 Flight Planning Instructions

Instructions in this section shall govern the flight planning of experiment activities during both the premission and real-time periods of the mission. These instructions cover planning under nominal conditions and contingency situations. Since situations can exist which increase as well as decrease scheduling opportunities for individual or group experiments, the instructions also cover the scheduling of experiments to their baseline requirements, minimum scheduling requirements, performance redline requirements, and levels above the baseline requirements.

In the flight planning of a typical crew day, the functions required to maintain the crew and the vehicle and experiment systems are scheduled first. These functions consist of such things as eating, sleeping, personal hygiene, and systems housekeeping. Other activities which must be performed each day are urine collection and processing, the weighing of food residue, review of teleprinter information, and mission planning.

After these activities are scheduled, the group-related experiments (in-flight medical, ATM, and EREP) are scheduled. The corollary experiments, student investigations, and non-mandatory subsystem/operational tests are then scheduled in the remaining time. Candidate experiments shall be scheduled as described in paragraph 2.3.4.1.1(b). Candidate student investigations shall be scheduled as described in paragraph 2.3.4.1.2.

Those systems/operational tests designated mandatory shall be incorporated into either systems housekeeping, experiment preparation, or other life/systems support activities as appropriate. Those tests which are non-mandatory shall be scheduled on a non-interference basis with experiments, student investigations, and mandatory tests.

2.3.4.2.1 DTO Performance Requirements

To assist in proper allocation of available mission and crew time for various flight activities, the requirements of experiments, student investigation, and systems/operational tests are stated in a hierarchy of three levels. These levels are 1) baseline requirements, 2) minimum scheduling requirements, and 3) performance redline requirements. These levels and their use are explained in the following paragraphs. The requirements are stated in Section 3 of this document.

2.3.4.2.2 Baseline Requirements

The baseline requirements are the maximum requirements which have been requested by the PI, accepted by the Program Director, and documented in the MRD. The goal of both premission planning and real-time planning shall be performance of the baseline requirements for all assigned experiments. Attainment of baseline requirements for group-related experiments has first priority, followed by corollary experiments and student investigations in order of decreasing FSP.

2.3.4.2.3 Minimum Scheduling Requirements

The minimum scheduling requirements are a reduced level of experiment requirements which have been directed by the Program Director, agreed to by the sponsoring office, and documented in the MRD. If it is impossible to attain the baseline requirements on all experiments capable of accomplishment, flight planning toward the minimum scheduling requirements will be implemented. Experiments without minimum requirements will continue to be scheduled toward baseline requirements. Attainment of the minimum requirements on the affected experiments will be of the same importance as attainment of the baseline requirements on those not affected. Experiments will be considered for reduction toward minimum scheduling requirements in sequence of increasing FSP.

During the premission period, if the minimum scheduling requirements have been implemented and there is still not enough crew time available to satisfy all requirements, the Skylab Program Offices will recommend to the Program Director further reductions in experiment requirements. The guidelines for determining the reductions are:

- a) Experiments will be considered for reduction in requirements in order of increasing FSP.

- b) An experiment's requirement will not be reduced unless it can be determined that the time made available is usable by an experiment(s) of higher FSP.

In the event real-time difficulties prevent the attainment of the requirements as planned permission, further reductions and/or cancellation of experiments will be considered. When the problems are not directly related to experiment activity but cause loss of crew time scheduled for experiment performances, each experiment discipline shall lose reschedule time in direct proportion to the total SL-3 crew time allocated to that experiment discipline. If the real-time problems are directly related to specific experiments or specific experiment disciplines, the following instructions shall apply:

- a) When crew time has been expended on a group related experiment run, any time scheduled for a repeat of that run shall normally be absorbed within that discipline.
- b) When crew time has been expended on a corollary experiment, a rescheduled performance shall normally be absorbed within any timeline allocation remaining for that specific experiment; however, other corollary experiments of lower FSP may be considered for reduction/cancellation in order to accommodate a rerun.

If the real-time problems are not directly related to experiment activity but cause loss of crew time scheduled for experiment performances, each experiment discipline shall absorb the lost time in direct proportion to the total SL-3 crew time allocated to that experiment disciplined.

The Flight Management Team will be briefed on any plan for reducing requirements and/or cancellation of experiments prior to their implementation.

2.3.4.2.4 Performance Redline Requirements

The performance redline requirements represent the minimum level of requirements which can be performed and still obtain worthwhile information for the experiments. Performance redline requirements will be established by the Program Director for all experiments. In the event real-time difficulties prevent attainment of the minimum scheduling requirements, flight planning toward the performance redline requirements and/or cancellation of experiments will be considered. Performance of less than the redline requirements will not be scheduled. If the redline requirements are considered for implementation the following guidelines and the guidelines stated in section 2.3.4.2.3 will apply:

- a) Guidelines for group-related experiments are TBD.
- b) Guidelines for the ATM Joint Observing Programs are TBD.
- c) Guidelines for the EREP tasks are TBD.
- d) If unable to achieve the redline requirements for all experiments capable of performance, experiments will be considered for cancellation from the mission in order of increasing FSP.

The Flight Management Team will be briefed on any plans to reduce toward the performance redline requirements and/or cancel experiments prior to their implementation.

In establishing the performance redline for mission SL-3, assumptions are made that (1) there will be a follow-on mission, (2) EVA will be performed on mission SL-3, and (3) there will be full data return capability (not a rescue situation). If these assumptions prove to be invalid in the real-time contingency situation, the performance redline requirements will be revised to be consistent with the existing situation.

2.3.4.2.5 Scheduling of Levels Above Baseline Requirements for Experiments

In general, no increase in scheduling beyond baseline requirements will be approved for an experiment until all other assigned experiments and candidate experiments capable of accomplishment are scheduled to the maximum extent possible toward their baseline requirements. Experiments will be considered for scheduling beyond their baseline requirements in order of decreasing FSP.

2.3.4.2.6 Special Scheduling Requirements

The following are special SL-3 guidelines for the scheduling of flight activities as derived from Program Directive No. 43C (Reference 1).

- *a) Crew-attended ATM operations shall be given scheduling priority for one crewman, exclusive of those periods allocated to EREP, for all daylight passes (plus the necessary night periods) for all identified experiment days. The ATM target schedule is 230 daylight hours, excluding ATM checkout, above the 400 kilometer observing constraint.
- b) Unattended ATM operations may be scheduled during any period in which the ATM console is not manned, provided such scheduling does not contradict other requirements specified in this document.
- c) The ATM experiments (excluding S055A) and H-alpha I shall each utilize not more than two magazines of film.
- d) The EREP experiments (excluding S190B), shall be scheduled for operation on 26 Z-local vertical passes. In addition, two solar inertial passes (of the five solar inertial passes of the EREP program) are assigned to satisfy EREP calibration requirements for this mission.
- e) The S190B experiment shall be scheduled for operation on at least 20 of the Z-local vertical passes and on the two calibration passes identified in (d) above.
- f) Student investigations requiring crew time may be scheduled to use up to 1-1/2 man hours per week, regardless of the FSP of experiments competing for the same time.
- g) ATM JOP-13 maneuvers shall not be scheduled at times that would interfere with operational requirements of corollary experiments.

*This change will be included in the next Program Directive No. 43C update.

2.3.5 Unmanned Operations Guidelines

2.3.5.1 Unmanned Operations

- a) The following guidelines apply to the unmanned period of SWS operations between separation of the SL-2 CSM and docking of the SL-3 CSM.
 - 1) The SWS shall be controlled and interrogated from the ground during the unmanned phase.
 - 2) Film for ATM experiments S052 and S054 shall be loaded during the end-of-mission SL-2 EVA for exposure during the unmanned phase of SL-3. This film will remain in the experiment canisters until the midmission SL-3 EVA. No film shall be provided beyond that specified in Table 3-1.
- b) The unmanned phase that follows separation of the SL-3 CSM from the SWS will be part of the SL-4 mission.

2.3.5.2 Unmanned Preparations

The Saturn Workshop will be prepared for unmanned operations and for subsequent reuse at the conclusion of the SL-3 mission. Preparation for the unmanned period will be as follows:

- a) Attitude. The SWS will be left in a solar-inertial stabilized attitude. If attitude rates are induced upon CSM undocking, the APCS will damp these rates and return the SWS to a solar inertial stabilized attitude.
- b) Monitoring. The SWS communication and data systems must be capable of providing SWS status during the storage period.
- c) Pressurization. The SWS habitable areas shall be depressurized after separation of the CSM. Venting shall be initiated by ground command within one orbit following CSM separation and shall be terminated by ground command when the pressure level is approximately 2.0 psia. Subsequently, the SWS internal pressure shall be allowed to decay to a minimum of 0.5 psia during the unmanned phase.
- d) Systems. Those systems necessary to support the SWS communication and data system, and those necessary to provide attitude and thermal control, will be required to operate during the storage period.
- e) Experiments. Film for ATM experiments S052 and S054 shall be loaded during the end of mission SL-3 EVA for exposure during the unmanned period of SL-4. Additionally, a set of Experiment S149 Micrometeorite Impact Detection Cassettes shall be prepared for exposure during the unmanned period of SL-4.

2.3.6 Non-Nominal Missions

All non-nominal mission planning shall be within the capabilities of cluster systems as defined in the Cluster Requirements Specification (Reference 2).

2.3.7 Film Requirements

Film quantity and processing requirements are provided in Table 2.1.

Table 2-1. Film Quantity and Processing Requirements

Experiment	Film		Processor	Chemistry	Remarks
	Type	Quantity			
M151	16 mm - S0168	15 - 400-ft cassettes	RAM	ME-4	One 400-ft cassette is reserved for experiment M131. Processed by JSC.
M487	16 mm - S0168	1 - 400-ft cassette	RAM	ME-4	Processed by JSC.
M509*	16 mm - S0168	*5 - 400 ft cassettes	RAM	ME-4	Processed by JSC. *Includes 0.5 cassette for T020.
	35 mm - S0168	**	Houston	ME-4	**Included in operational film budget, max total of 70 frames for all 3 missions.
M516	16 mm - S0168	1 - 400 ft cassette	RAM	ME-4	Processed by JSC.
S019	101-06	1 - film mag. (164 frames)			Processed by PI.
S052	35 mm - Kodak 026-02	2 cameras 8025 frames per camera 750 feet per camera			Processed by PI. Processing subcontracted to Aerospace Corp.
S054	70 mm - S0212	2 magazines 7200 frames per magazine			Processed by PI.

Table 2-1. Film Quantity and Processing Requirements (Continued)

Experiment	Film		Processor	Chemistry	Remarks
	Type	Quantity			
S056	35 mm - Kodak S0212	2 magazines 7200 frames per magazine	Hi-Speed	D-19	Processed by JSC.
S063	35 mm - 2485 -S0368	2 cassettes 2 cassettes	Hi-Speed Houston	D-19 ME-4	Processed by JSC.
S082A	Kodak Plus-X Chip and 104-06 SWR	2 magazines 200 exposures per magazine (400 film strips)			Processed by PI. Duplication of film to be performed at JSC.
S082B	Kodak Plus-X Chip and 104-06 SWR	2 magazines 1600 exposures per magazine (400 Film strips)			Processed by PI. Duplication of film to be performed at JSC.
S183	16 mm - 103a0 35 mm - SC-5	1 - 140-ft mag. 36 frames	Hi-Speed	D-19	Processed by PI. Darkroom facilities provided by JSC.
S190A	S0356 S0022 EK2424 EK2443	5 cassettes 10 cassettes 5 cassettes 5 cassettes	Houston Fultron Hi-Speed Versamat 1811	ME-4 MX-819 D-19 EA-5	Processed by JSC.
S190B*	S0242 EK3443 EK3400 EK3414	6 canisters	Versamat 1811 Versamat 1811 Fultron Fultron	EA-5 EA-5 MX-819 MX-819	Processed by JSC. *Types listed are all under consideration.

Table 2-1. Film Quantity and Processing Requirements (Continued)

Experiment	Film		Processor	Chemistry	Remarks
	Type	Quantity			
S191	16 mm - 3401	4 - 140-ft mag.	Houston (B&W)	D-19	Processed by JSC.
T013	16 mm - S0168	2 - 400-ft cassettes	RAM	ME-4	Processed by JSC.
T020	16 mm - S0168	1/2 - 400-ft cassette**	RAM	ME-4	Processed by JSC.
	- S0168	3 - 140-ft magazines	RAM	ME-4	**Included in M509 film allotment.
	35 mm - S0168	***	Houston	ME-4	*** 10 frames total for SL-3 and SL-4 included in operational film budget.
T027/ S073	16 mm - 2485	3 - 140-ft mag.	Hi-Speed	D-19	Processed by JSC.
Hα1	35 mm - Solar Flare Patrol Type S0101	2 magazines 1600 frames per magazine			Processed by PI. Processing subcontracted to Aerospace Corp.
Operational	16 mm - S0168	4 - 400-ft cassettes	RAM	ME-5	Processed by JSC.
	16 mm - S0368	3 - 140-ft magazines	Hi-Speed	ME-2A	
	35 mm - S0168	10 cassettes	Houston	ME-4	
	70 mm - S0368	2 cassettes	Hi-Speed	ME-2A	
Student Investi- gations	16 mm - S0168	1 cassette	RAM	ME-4	Processed by JSC.
	35 mm - S0168	1 cassette	Houston	ME-4	

2.3.8 Skylab Video Documentation Project Requirements for Television

Specific Skylab Video Documentation Project requirements for television are provided in Table 2-2. These TV requirements have the same scheduling priority and are to be scheduled in the same manner as the group related experiments - ATM, EREP and medical. All activities in Table 2-2 are to be scheduled and all activities have equal priority.

Video shall be returned to JSC on the same day or one day after it is recorded whenever it is possible to use CONUS stations. Use of CONUS stations shall have first priority. HAW, BDA, or VAN may be used if required for onboard video tape management. Tapes from HAW, BDA, and VAN shall be returned to JSC without delay.

Out-the-window telecasts require coverage of the entire pass across the land mass (i.e., from open ocean to open ocean). All portions of out-the-window passes which fall within coverage of GDS, TEX, MIL, and MAD will be released live. Portions of the passes which are outside the coverage of these stations will be recorded onboard and dumped through CONUS stations for same day or next day release. When possible, onboard VTR operations associated with out-the-window telecasts will be controlled by ground command.

Three telecasts (SMMD/water gun, preparing next meal, and eating) are to be edited together and have crewman assignment requirements as follows:

- a) Either the CDR or PLT must perform SMMD/water gun.
- b) The crewman who performs SMMD/water gun must perform SMMD operations within the preparing-next-meal telecast.
- c) The crewman who performs SMMD/water gun should drink from the water gun during eating.

In order to assure coordination for the TV requirements scheduling and change requests, a television officer is part of the JSC FOMR team.

Television requirements established preflight will use a very high percentage of the capability to record and dump video. Any new television use, such as trouble shooting of vehicle anomalies may impact the ability to complete these requirements and will require FOMR approval.

Skylab television planning has been tailored to provide for use by a variety of users such as commercial network television, educational television and films, and documentary producers. The Public Affairs Office will serve as the single point of contact with all television users outside NASA.

Table 2-2. Summary of SL-3 Telecasts

Activity	Scenes	Taped Telecasts
1. M509 - Astronaut Maneuvering Unit	2	Preparation and operations
2. T013 - Crew/Vehicle Disturbances	<u>TBD</u>	<u>TBD</u>
3. T020 - Foot Controlled Maneuvering Unit	<u>TBD</u>	<u>TBD</u>
4. ED32 - In Vitro Immunology	<u>TBD</u>	<u>TBD</u>
5. ED52 - Web Formation	<u>TBD</u>	<u>TBD</u>
6. ED63 - Cytoplasmic Streaming	<u>TBD</u>	<u>TBD</u>
7. ED74 - Mass Measurement	<u>TBD</u>	<u>TBD</u>
8. S063 - UV Airglow Horizon Photography	<u>TBD</u>	<u>TBD</u>
9. S019 - UV Stellar Astronomy	<u>TBD</u>	<u>TBD</u>
10. Science Demonstrations (8)	<u>TBD</u>	<u>TBD</u>
	<u>TBD</u>	<u>TBD</u>
	<u>TBD</u>	<u>TBD</u>
	<u>TBD</u>	<u>TBD</u>
	<u>TBD</u>	<u>TBD</u>
	<u>TBD</u>	<u>TBD</u>
	<u>TBD</u>	<u>TBD</u>
	<u>TBD</u>	<u>TBD</u>
11. M133 - Sleep Monitoring	4	System demonstration
12. Science Pilot Highlights (4)	1	Solar activity special
	1	Solar activity special
	1	Solar activity special
	1	Solar activity special
13. Rendezvous	1	(If within station contact)
14. EVA (3)	1	Tape and live
	1	Tape and live
	1	Tape and live
15. M071/M074/M110 Series/M172- Body Fluid, Mineral Balance, Blood Studies and Mass Measurement	2	Eating
	6	Prepare next meal
	4	SMMD/water gun
	5	Blood sampling
	4	Body mass measurement

Table 2-2. Summary of SL-3 Telecasts (Continued)

	Activity	Scenes	Taped Telecasts
16.	EREP - Earth Resources Sensors	5 1	Sensor operations Tape reloading
17.	M092/M093/M171 - Cardio-vascular and Metabolic Activity	4 1 4 6	Lower body negative press (part 1) Lower body negative press (part 2) Vectorcardiogram Metabolic activity
18.	M487/M516/M151 - Habitability/Crew Quarters, Crew Activities/Maintenance, Time and Motion	2 3 (Note 1)	Entertainment center Sleep restraint/trash/shower Personal hygiene
19.	ATM Operations (3)	TBD <u>TBD</u> <u>TBD</u>	TBD <u>TBD</u> <u>TBD</u>
20.	M131 - Human Vestibular Function	4 3 4	Oculogyral illusion mode Motion sensitivity mode Spatial localization mode
21.	S183 - Ultraviolet Panorama	3	Deploy AMS and spectrograph
22.	EREP: Viewfinder Tracking System (VTS) and Out-the-Window. (10 U.S. and 10 Foreign)	1 1	Out-the-window Out-the-window Out-the-window Out-the-window Out-the-window Out-the-window Out-the-window Out-the-window Out-the-window Out-the-window Viewfinder tracking system Viewfinder tracking system Viewfinder tracking system Viewfinder tracking system Viewfinder tracking system Viewfinder tracking system Viewfinder tracking system Viewfinder tracking system Viewfinder tracking system Viewfinder tracking system Viewfinder tracking system Viewfinder tracking system Viewfinder tracking system Viewfinder tracking system Viewfinder tracking system Viewfinder tracking system
23.	Tours (3)	(Note 1) (Note 1) (Note 1)	Crewquarters deck tour MDA/AM OWS forward compartment
24.	Press Conference	1	Live press conference
25.	End-of-mission Fly-around	1	Live

Note: 1. TV camera will be hand held and the number of scans may vary.

3.0 SL-3 MISSION DETAILED TEST OBJECTIVES

3.1 GENERAL

This section identifies the experiments that have been approved by the Associate Administrator for Manned Space Flight for implementation on the Skylab Program and subsystem/operational Detailed Test Objectives (DTO's) as approved by the JSC and MSFC Skylab Program Managers. In consonance therewith, OMSF, Headquarters Program Directive No. 43C (Reference 1) has assigned experiments to specific missions, or, in lieu of stating specific assignments, has established other instructions for planning and performing the experiments. General guidelines for the scheduling of experiments in the mission flight plans are listed in Table 3-1 and are derived from NASA Headquarters Program Directive No. 43C and approved changes thereto. Changes to the guidelines listed in the table require Level I (NASA Headquarters) approval.

This section shall constitute the controlling requirements necessary for fulfilling the mission objectives stipulated in Program Directive 43C. It is intended for use by those organizations concerned with flight planning, mission rules, procedures, data and support requirements, and mission evaluations.

The percentages (where shown) with each Functional Objective (FO) of the corollary DTO's represent a weighted value of the FO within the DTO. The sum of FO weights totals 100 percent. The weights represent that percentage of the corollary DTO which is completed when the respective FO has been satisfied.

3.1.1 Experiment and Student Investigation Assignments and Scheduling Instructions Table

3.1.1.1 Format

Table 3-1 places each experiment or investigation in one of two groups: in-flight experiments and pre- and postflight experiments. The in-flight experiments and investigations are divided further into four subgroups:

- a) Passive Experiments - - in-flight experiments whose crew support requirements are either insignificant or non-existent.
- b) Group-related Experiments - - experiments that are closely related to each other either through common study of the flight crew or by integration into a single subsystem. Three sets of group-related experiments are assigned in Table 3-1: Medical, Solar Astronomy (ATM), and Earth Resources (EREP).
- c) Corollary Experiments - - other in-flight experiments that require significant in-flight crew support but which are not as closely related to each other as are the experiments addressed in (b) above.
- d) Student Investigations - - investigations selected through the Skylab Student Project that may or may not require in-flight crew support.

3.1.1.2 Experiment and Student Investigation Assignments and Scheduling Instructions

Table 3-1 establishes detailed mission assignment and scheduling instructions for planning and performing the experiments and student investigations. (Where explicit instructions are not shown in Table 3-1, those documented elsewhere in the MRD shall apply.) The table is organized by the groups and subgroups of experiments and student investigations that are defined in Section 3.1.2.1. Table 3-1 also establishes an FSP number for each of the corollary experiments. Use of the FSP number in mission planning is discussed in Section 2.3.4.

Table 3-1. Skylab Experiment and Student Investigation Assignments and Scheduling Instructions

Experiment Group	Experiment		Mission Assignments/Scheduling Instructions	FSP
	Number	Title		
Passive	M415	Thermal Control Coatings	This experiment is assigned to the SL-2 flight (the experiment hardware is mounted on the Saturn IB 206 launch vehicle).	N/A
	S071	Circadian Rhythm - Pocket Mice	These experiments are assigned to Mission SL-3 (the experiment hardware is integrated into SM 117).	N/A
	S072	Circadian Rhythm - Vinegar Gnats		
	S150	Galactic X-Ray Mapping (B)	This experiment is assigned to Mission SL-3.	N/A

Table 3-1. Skylab Experiment and Student Investigation Assignments and Scheduling Instructions (Continued)

Experiment Group	Experiment		Mission Assignments/Scheduling Instructions	FSP
	Number	Title		
Medical	M071	Mineral Balance	<p>These experiments are assigned to Missions SL-1/SL-2, SL-3, and SL-4.</p> <p>*These experiments have pre- and post-flight requirements only.</p>	N/A
	M073	Bioassay of Body Fluids		
	M074	Specimen Mass Measurement		
	*M078	Bone Mineral Measurement		
	M092	In-Flight Lower Body Negative Pressure		
	M093	Vectorcardiogram		
	*M111	Cytogenetic Studies of Blood		
	M112	Man's Immunity - In vitro aspects		
	M113	Blood Volume and Red Cell Life Span		
	M114	Red Blood Cell Metabolism		
	M115	Special Hematologic Effects		
	M171	Metabolic Activity		
	M172	Body Mass Measurement		
	M131	Human Vestibular Function	<p>This experiment is assigned to Missions SL-1/SL-2, SL-3 and SL-4. Five Motion Sensitivity (MS) and Oculogyral Illusion (OGI) threshold tests shall be performed on each of two crewmen for a total of ten tests during SL-1/SL-2. Six MS and OGI threshold tests shall be performed on each of two crewmen for a total of 12 tests on each of missions SL-3 and SL-4.</p>	N/A

Table 3-1. Skylab Experiment and Student Investigation Assignments and Scheduling Instructions (Continued)

Experiment Group	Experiment		Mission Assignments/Scheduling Instructions	FSP
	Number	Title		
	M133	Sleep Monitoring	This experiment shall be performed in 15 sleep-sessions on Mission SL-1/SL-2, and in 21 sleep-sessions on Mission SL-3.	N/A
	M151	Time and Motion Study	This experiment is assigned to Missions SL-1/SL-2, SL-3, and SL-4. It shall be performed only in conjunction with other experiments.	420
ATM	S052	White Light Coronagraph	These experiments are assigned to Missions SL-1/SL-2, SL-3, and SL-4. The full requirements in terms of data-taking hours for each mission are identified in the appropriate pre-mission planning sections of this document. These experiments, excluding S055, shall utilize not more than: <u>One</u> magazine of film on SL-1/SL-2 <u>Two</u> magazines of film on SL-3 <u>One</u> magazine of film on SL-4	N/A
	S054	X-Ray Spectrographic Telescope		
	S055	UV Spectrometer (A)		
	S056	Dual X-Ray Telescope		
	S082	UV Spectrograph/Heliograph		
EREP*	S190	Multispectral Photographic Facility S190A - Multispectral Photographic Cameras S190B - Earth Terrain Camera	These experiments are assigned to Missions SL-1/SL-2, SL-3, and SL-4. With the exception of S190B, they shall be scheduled for operation on a total of 60 Z-local vertical passes and five solar-inertial passes. The S190B experiments shall be scheduled for operation on a minimum of 45 Z-local vertical passes. * For SL-3 requirements, refer to Appendix B to the MRD.	N/A
	S191	Infrared Spectrometer		
	S192	Multispectral Scanner		
	S193	Microwave Radiometer/Scatterometer and Altimeter		
	S194	L-Band Radiometer		

Table 3-1. Skylab Experiment and Student Investigation Assignments and Scheduling Instructions (Continued)

Experiment Group	Experiment		Mission Assignments/Scheduling Instructions	FSP
	Number	Title		
Corollary (Individual Experiments)	D008	Radiation in Spacecraft	Four active dosimeter surveys shall be performed on Mission SL-1/SL-2 (the experiment is integrated in CM 116).	220
	D024*	Thermal Control Coatings	Two sample panels shall be retrieved on Mission SL-1/SL-2; the remaining two sample panels shall be retrieved on either SL-3 or SL-4.	230
	M479	Zero Gravity Flammability	A total of five sets of test cycles shall be performed as close to the termination of the SL-4 mission as possible so as not to contaminate any experiments having sensor equipment external to the spacecraft.	210
	M487	Habitability/Crew Quarters	This experiment shall be performed on Missions SL-1/SL-2, SL-3, and SL-4.	470
	M509	Astronaut Maneuvering Equipment	Four experiment runs (three unsuited and one suited) shall be performed by each of three crewmen (nine unsuited and three suited runs total). One crewman shall perform a set of four runs on SL-3 and two crewmen shall perform two sets of four runs each on SL-4. If a portion of the 12 runs are accomplished as a candidate experiment on SL-1/SL-2, the set of runs for the second crewman on SL-4 shall be reduced accordingly. The crewman performing the experiment shall be accompanied by an observer. At least one crewman who performs M509 shall also perform one set of experiment runs on experiment T020.	300

* Candidate experiment for Mission SL-3 - refer to paragraph 2.3.4.1.1(b).

Table 3-1. Skylab Experiment and Student Investigation Assignments and Scheduling Instructions (Continued)

Experiment Group	Number	Experiment	Mission Assignments/Scheduling Instructions	FSP
		Title		
Corollary (Individual Experiments)	M516	Crew Activities/Maintenance Study	This experiment is assigned to Missions SL-1/SL-2, SL-3, and SL-4. The fine manipulation maintenance tasks shall be performed on Mission SL-4.	380
	M551	Metals Melting	This experiment is assigned to Mission SL-1/SL-2.	190
	M552	Exothermic Brazing	This experiment is assigned to Mission SL-1/SL-2.	150
	M553	Sphere Forming	This experiment is assigned to Mission SL-1/SL-2.	160
	M556	Vapor Growth of II-VI Compounds	This experiment is assigned to Mission SL-4. This experiment shall be the last experiment performed in the M518 facility because of the possible toxicity hazard.	350
	M557	Immiscible Alloy Composition	This experiment is assigned to Mission SL-4.	440
	M558	Radioactive Tracer Diffusion	This experiment is assigned to Mission SL-4. This experiment shall be the next to last experiment performed in the M518 facility because of the possible toxicity hazard.	430
	M559	Microsegregation in Germanium	This experiment is assigned to Mission SL-4.	320

Table 3-1. Skylab Experiment and Student Investigation Assignments and Scheduling Instructions (Continued)

Experiment Group	Experiment		Mission Assignments/Scheduling Instructions	FSP
	Number	Title		
Corollary (Individual Experiments)	M560	Growth of Spherical Crystals	This experiment is assigned to Mission SL-4.	310
	M561	Whisker Reinforced Composites	This experiment is assigned to Mission SL-4.	360
	M562	Indium Antimonide Crystals	This experiment is assigned to Mission SL-4.	480
	M563	Mixed III-V Crystal Growth	This experiment is assigned to Mission SL-4.	390
	M564	Metal and Halide Eutectics	This experiment is assigned to Mission SL-4.	270
	M565	Silver Grids Melted in Space	This experiment is assigned to Mission SL-4.	260
	M566	Copper-Aluminum Eutectics	This experiment is assigned to Mission SL-4.	400

Table 3-1. Skylab Experiment and Student Investigation Assignments and Scheduling Instructions (Continued)

Experiment Group	Experiment		Mission Assignments/Scheduling Instructions	FSP
	Number	Title		
Corollary (Individual Experiments)	S009	Nuclear Emulsion	One nuclear emulsion detector package shall be exposed and retrieved on Mission SL-1/SL-2.	180
	S019	UV Stellar Astronomy	One hundred fifty data exposures, requiring the equivalent of 12 night passes averaging 32 minutes each, shall be obtained on each of Missions SL-1/SL-2 and SL-3. The experiment shall be a candidate for further activity on SL-4.	500
	S063	UV Airglow Horizon Photography	A total of 1BD data exposures shall be obtained on SL-3 and SL-4 missions.	240
	S149	Particle Collection	Four sets of detector cassettes shall be deployed, exposed, and retrieved. One set shall be exposed during the unmanned portion of Mission SL-3, and one set shall be exposed on the manned portion of SL-3. In addition, one set shall be exposed on the unmanned portion of SL-4 and one shall be exposed on manned portion of SL-4.	450
	S183	UV Panorama	Thirty-five data exposures shall be obtained on Mission SL-1/SL-2; another 35 data exposures shall be obtained on SL-3. The experiment shall be a candidate for further activity on SL-4.	490
	S228	Trans-Uranic Cosmic Rays	This experiment shall be deployed on Mission SL-1/SL-2 and retrieved on Mission SL-4.	275

Table 3-1. Skylab Experiment and Student Investigation Assignments and Scheduling Instructions (Continued)

Experiment Group	Experiment		Mission Assignments/Scheduling Instructions	FSP
	Number	Title		
Corollary (Individual Experiments)	S230	Magnetospheric Particle Composition	The experiment hardware shall be re-tried on the SL-3 and SL-4 missions.	165
	T002	Manual Navigation Sightings (B)	This experiment shall be performed on Missions SL-3 and SL-4 at the convenience of the crew and on a non-interference basis with the other experiments.	140
	T003	In-Flight Aerosol Analysis	This experiment shall be performed on Missions SL-1/SL-2, SL-3, and SL-4.	460
	T013*	Crew/Vehicle Disturbances	This experiment shall be performed in the OWS on either Mission SL-3 or Mission SL-4.	340
	T020	Foot Controlled Maneuvering Unit	Each of two crewmen shall perform a set of five experiment runs (three unsuited and two suited). The experiment shall be performed by one crewman on Mission SL-3 and by another crewman on Mission SL-4. At least one of the crewmen who performs T020 shall also perform one set of experiment runs on M509.	250
	T027/ S073	Contamination Measurement and Gegenschein/Zodiacal Light	This is a joint experiment utilizing the T027 photometer system. Thirteen (13) program performances shall be performed on Mission SL-1/SL-2. Thirty (30) program performances shall be performed on each of Missions SL-3 and SL-4.	410

* Candidate experiment for Mission SL-3 - refer to paragraph 2.3.4.1.1(b).

Table 3-1. Skylab Experiment and Student Investigation Assignments and Scheduling Instructions (Continued)

Group	Investigation		Mission Assignments/Scheduling Instructions	FSP
	Number	Title		
Student Investigations	ED11*	Atmospheric Absorption of Heat	This investigation is assigned to Mission SL-1/SL-2 and is a candidate for SL-3 and SL-4.	N/A
	ED12*	Volcanic Study	This investigation is assigned to Mission SL-1/SL-2 and is a candidate for SL-3 and SL-4.	N/A
	ED21	Libration Clouds	This investigation is assigned to Mission SL-3.	N/A
	ED22*	Objects within Mercury's Orbit	This investigation is assigned to Mission SL-1/SL-2 and is a candidate for SL-3 and SL-4.	N/A
	ED23	UV from Quasars	This investigation is assigned to Mission SL-1/SL-2. Data will be taken during one night pass using S019 equipment.	N/A
	ED24	X-Ray Stellar Classes	This investigation is assigned to Mission SL-4.	N/A
	ED25	X-Rays from Jupiter	This investigation is assigned to Mission SL-3.	N/A
	ED26	UV from Pulsars	This investigation is assigned to Mission SL-1/SL-2. Data will be taken during one night pass using S019 equipment.	N/A
	ED31	Bacteria and Spores	This investigation is assigned to Mission SL-1/SL-2.	N/A
	ED32	In Vitro Immunology	This investigation is assigned to Mission SL-3.	N/A
	ED41	Motor Sensory Performance	This investigation is assigned to Mission SL-4.	N/A
	ED52	Web Formation	This investigation is assigned to Mission SL-3.	N/A

* Candidate investigation for Mission SL-3 - refer to paragraph 2.3.4.1.2.

Table 3-1. Skylab Experiment and Student Investigation Assignments and Scheduling Instructions (Continued)

Group	Investigation		Mission Assignments/Scheduling Instructions	FSP
	Number	Title		
Student Investigations	ED61/62	Plant Growth/Plant Phototropism	This investigation is assigned to Mission SL-4.	N/A
	ED63	Cytoplasmic Streaming	This investigation is assigned to Mission SL-3.	N/A
	ED72	Capillary Study	This investigation is assigned to Mission SL-4.	N/A
	ED74	Mass Measurement	This investigation is assigned to Mission SL-3.	N/A
	ED76	Neutron Analysis	This investigation is assigned to Mission SL-1/SL-2, SL-3* and SL-4. * Note: This investigation is passive on Mission SL-3	N/A
	ED78	Liquid Motion in Zero "G"	This investigation is assigned to Mission SL-4.	N/A

3.2 EXPERIMENT AND STUDENT INVESTIGATION DETAILED TEST OBJECTIVES

3.2.1 Medical Experiments

3.2.1.1 General

A series of medical experiments will be carried out on Skylab mission SL-3 to determine man's ability to live and work in space for extended periods.

The data will be used to determine the effects on the crew resulting from a space flight of up to 56 days duration and to determine if a subsequent mission of greater than 56 days duration is feasible and advisable.

3.2.1.2 Medical DTO's

The inflight medical experiments assigned to the Skylab SL-3 mission are:

M071	Mineral Balance
M073	Bioassay of Body Fluids
M074	Specimen Mass Measurement
M092	In-Flight Lower Body Negative Pressure
M093	Vectorcardiogram
M112	One DTO (M110 Series) covers the in-flight requirements for all four experiments
M113	
M114	
M115	
M131	Human Vestibular Function
M133	Sleep Monitoring
M151	Time and Motion Study
M171	Metabolic Activity
M172	Body Mass Measurement

The DTO's are presented in alphanumeric order on the following pages.

Obtain data on metabolic constituents.

Purpose and Background

The purpose is to determine the effects of space flight on the muscle and skeletal body systems by quantitative assessment of the gains and losses of pertinent biochemical (metabolic) constituents.

Continuous losses of calcium and nitrogen, such as those which occur in ground-based simulation studies, during long duration missions might result in impairment of skeletal and muscle integrity and the formation of renal calculi. Identification of the rates of actual deterioration will allow specific countermeasures (such as the institution of exercise routines and the manipulation of dietary constituents) to be taken on later flights. Data from this experiment will provide for definition and quantitative assessment of the gains and losses from the body of various biochemical constituents, particularly water, calcium, and nitrogen, during space flight. Preflight data will establish baseline norms for understanding in-flight and postflight changes. Electrolyte analysis will utilize blood samples from M110.

Functional Objectives

● Determine the effects of space flight on the muscle and skeletal body systems by quantitative assessment of the gains and losses of pertinent biochemical (metabolic) constituents.

- FO 1) Measure and record the total diet residue, menu deviations, and total daily fluid intake for each crewman throughout the mission.
- FO 2) Collect, identify, measure, and process all urine eliminations of each crewman throughout the mission.
- FO 3) Collect, identify, measure, process, and store for return a homogeneous urine sample of at least 45 ml (except when half samples are collected) every 24 hours for each crewman, throughout the mission.
- FO 4) Collect, identify, measure, process, and store for return all fecal eliminations (and vomitus) of each crewman throughout the mission.
- FO 5) Measure and record body mass of each crewman once every 24 hours throughout the mission.

Performance Requirements

a) Baseline Requirement

- FO 1) Perform each of these four FO's each day for each crewman.
- FO 2)
- FO 3)
- FO 5)
- FO 4) Perform this FO upon each occurrence.

b) Minimum Scheduling Requirement

FO 1) Same as the baseline requirement
thru
FO 5)

c) Performance Redline

FO 1) Continue to schedule toward the baseline requirement.
thru
FO 5)

Performance Conditions

FO 1) Each crewman will consume a nominal menu as completely as possible and record any deviations.

The Specimen Mass Measurement Device (SMMD) will be used to establish the mass of unconsumed food per procedures contained in the appropriate checklist.

Individual water intake will be recorded daily.

FO 2) All urine passed in flight will be collected. Voids will be accumulated over each 24-hour period and maintained at $10^{\circ} \pm 5^{\circ}\text{C}$ ($50^{\circ} \pm 9^{\circ}\text{F}$).

Voids should be accumulated in 24-hour cycles for each crewman. Except for unusual circumstances, the 24-hour time period will be regularized by making the closeout time period within 30 minutes of the same hour each day.

FO 3) Within three hours after termination of the 24-hour urine pool collection, a 122 (+10, -0) -ml homogeneous sample (45 ml for M071, 75 ml for M073, and 2 ml for volume determination) will be withdrawn for each crewmember and frozen below -20°C (-4°F). Due to stowage considerations for M110 blood samples, twelve half samples of urine (at least 62 ml) will be collected per the following guidelines:

- 1) Full samples (i.e., 122 ml) will be collected the day before, the day of, and the day after collecting blood samples as defined by M110.
- 2) Full samples are required each day for the first seven days and for the last seven days of the mission.
- 3) Half samples are not to be taken on any two successive days.

Provisions must be made for identification of samples as to crewmember, date, and time. All samples will be stored for return.

FO 1) Within the limitation of the CM, these FO's will be supported
thru during ascent and recovery phases of the mission as well as
FO 4) during orbital operations. Measurement and preservation procedures will be performed in the OWS or recovery ship as required.

- FO 4) All fecal matter will be collected, mass measured, identified (crewman, wet mass, and time) and processed for return per procedures contained in the appropriate checklist.
- Two types of dye marker pills will be ingested at 6-day intervals in alternating sequence.
- Any vomitus passed will be collected, mass measured, identified (crewman, wet mass, and time), and processed for return.
- FO 5) Body mass of each crewman will be measured and recorded immediately after first urine voiding following the sleep period. This function will be accomplished using the Body Mass Measurement Device (BMMD).

In-Flight Data

- a) Telemetry - None
- b) Crew Voice Comments - Data on total food residues, menu deviations, total daily fluid intake, total daily voids, and daily body mass for each crewman.
- c) Log Books - Record of the total food residues, menu deviations, total daily fluid intake, total daily voids, and daily body mass for each crewman.
- d) Photographs - None
- e) Return Payload - Log books (if voice logging was not accomplished), samples of all urine voiding, all feces, and all vomitus will be returned.

For additional details, refer to Appendix A.

Evaluation

Refer to MSC-03022, Scientific Data Analysis and Reporting Plan.

Obtain daily crew urine samples.

Purpose and Background

The purpose is to evaluate the endocrinological adaptation resulting from extended exposure to space flight environment.

This experiment will identify changes in hormonal and associated fluid and electrolyte parameters. These changes will be reflected in the blood and urine of the crewmen participating in the Skylab flight. Postflight evaluation will indicate the rate(s) of readaptation to the preflight content levels. Preflight data will establish baseline norms for understanding in-flight and postflight changes. Data will be developed by analyzing urine and blood samples (from M110) and related fluid/electrolyte components. Accurate evaluation of these data will require the control and specific analysis of dietary and fluid ingestion.

Functional Objectives

- Evaluate the endocrinological adaptation resulting from extended exposure to space flight environment.

FO 1) Collect, identify, measure, process, and store for return, a homogeneous urine sample of at least 75 ml (except when half samples are collected) every 24 hours for each crewman, throughout the mission.

Performance Requirements

a) Baseline Requirement

FO 1) Voids will be accumulated in 24-hour cycles for each crewman.

b) Minimum Scheduling Requirement

FO 1) Same as the baseline requirement

c) Performance Redline

FO 1) Continue to schedule toward the baseline requirement.

Performance Conditions

FO 1) All urine passed in flight will be collected, identified (crewman, date, and time), processed, and a sample stored and returned.

Voids shall be accumulated for each crewmember over each 24-hour period and maintained at $10^{\circ} \pm 5^{\circ}\text{C}$ ($50^{\circ} \pm 9^{\circ}\text{F}$). Within three hours after termination of the 24-hour urine pool, a 122 (+10, -0) -ml homogeneous sample (75 ml for M073, 45 ml for M071, and 2 ml for volume determination) shall be withdrawn for each crewmember and frozen below -20°C (-4°F). Due to stowage considerations for M110 blood samples, half samples of urine (at least 62 ml, rather than 122 ml) will be collected on twelve days per the following guidelines:

- 1) Full samples (i.e., 122 ml) will be collected the day before, the day of, and the day after collecting blood samples as defined by M110.
- 2) Full samples are required each day for the first seven days and for the last seven days of the mission.
- 3) Half samples are not to be taken on any two successive days.

Voids accumulated in the 24-hour time period will be regularized by making the closeout time within 30 minutes of the same hour each day.

Within the limitations of the Command Module (CM), this experiment will be supported during ascent and recovery phases of the mission as well as during orbital operations. Measurement and preservation procedures will be performed in the OWS or recovery ship as required.

Urine samples will be stored in a passive freezer which maintains the maximum temperature below -10°C (14°F) at time of recovery.

In-Flight Data

- a) Telemetry - None
- b) Crew Voice Comments - None
- c) Log Books - None
- d) Photographs - None
- e) Return Payload - All frozen urine samples

For additional details, refer to Appendix A.

Evaluation

Refer to MSC-03022, Scientific Data Analysis and Reporting Plan.

Measure specimen mass in zero gravity.

Purpose and Background

The purposes are to demonstrate accurate nongravimetric measurement in spaceflight, to validate and explore limits of the spring/mass oscillator method of mass measurement, and to support biomedical experiments requiring mass measurement.

A set of known small masses will be used to establish a calibration under weightless conditions, which will necessarily be different from one-g calibration. This will allow comparison of unknown to known masses.

Functional Objectives

- Demonstrate mass measurement without gravity and validate theoretical characteristics of the device.

FO 1) Perform SMMD calibration validations using preflight calibrated
thru masses of 50, 100, 150, 250, 350, 500, 750, and 900 grams.
FO 3)

Performance Requirements

a) Baseline Requirement

FO 1) Calibration measurements will be taken on each of the two SMMD's
thru as soon as possible during OA activation (FO 1), and every
FO 3) 24 (+2) days thereafter (FO 2 and FO 3) for a total of three
performances.

b) Minimum Scheduling Requirement

FO 1) Same as the baseline requirement
thru
FO 3)

c) Performance Redline

FO 1) Continue to schedule toward the baseline requirement.
thru
FO 3)

Performance Conditions

FO 1) Each mass will be measured five times.
thru
FO 3) During performance of this experiment, the vehicle will be in
solar inertial attitude and momentum dumps will be inhibited.
Any measurements made during inadvertent shocks or accelerations
shall be repeated.

Calibration validation will be accomplished per procedures contained in the appropriate check list.

In-Flight Data

- a) Telemetry - None
- b) Crew Voice Comments - Calibration data [timer display, SMMD temperature, comments on SMMD operation, Greenwich Mean Time (GMT), specimen identification and SMMD unit identification] will be transmitted by voice to the ground. Calibration data will be made available to the Principal Investigator within 48 hours after each calibration sequence.
- c) Log Books - Calibration data (timer display, SMMD temperature, comments on SMMD operation, GMT, specimen identification, and SMMD unit identification) will be logged.
- d) Photographs - None
- e) Return Payload - Experiment log books

For additional details, refer to Appendix A.

Evaluation

Refer to MSC-03022, Scientific Data Analysis and Reporting Plan.

Obtain cardiovascular data in a zero-gravity environment.

Purpose and Background

The purpose is to detect and measure the degradation in cardiovascular function resulting from space flight.

Crewmen of Projects Mercury, Gemini and Apollo as well as subjects of recumbency and immersion studies, exhibited a reduced orthostatic tolerance when exposed to the stress of passive tilt table studies during the post-flight, postrecumbency, or postimmersion period. Characteristic features of this orthostatic response are cardioacceleration, lower extremity pooling of blood, and decreased pulse pressure. Severe orthostatism invariably results in syncope (loss of consciousness). Additionally, loss of body water (evidenced by weight loss), decrease in red blood cell mass, decrease in red blood cell survival time, and increase in red blood cell fragility have been demonstrated postflight in Gemini flight crews. Therefore, it is significant to future manned mission safety to detect and measure space flight cardiovascular adaptation (degradations in cardiovascular function which may impair manned performance during space flight or after return to earth's environment) and establish the time course of these changes.

Functional Objectives

- Detect and measure the degradation in cardiovascular function resulting from space flight.

FO 1) Perform the In-Flight Lower Body Negative Pressure
thru (LBNP) experiment using an LBNP device.
FO 17)

Performance Requirements

a) Baseline Requirement

FO 1) Each crewman will participate in the LBNP tests at approximately
thru the same time each day, every third day (FO 1 thru FO 17) during
FO 17) the mission. This will result in more than 17 LBNP tests per
crewman provided the every-third-day routine can be maintained.
It is permissible, when time constraints so dictate, to change
the three-day time interval by \pm one day; however, any such change
or combination of changes will not allow tests to be performed
on a given crewman on successive days. (Each FO will be completed when all three crewmen have completed a M092 performance.)

b) Minimum Scheduling Requirement

FO 1) Same as the baseline requirement
thru
FO 17)

c) Performance Redline

FO 1) Continue to schedule toward the baseline requirement.
thru
FO 17)

Performance Conditions

- FO 1) The experiment will be performed using each of the three astronauts as subjects per procedures contained in the appropriate checklist. One astronaut will be an observer for each run.
 FO 17)

This experiment will commence as soon as possible after Orbital Workshop (OWS) activation.

This experiment will not be performed for at least one hour if exercise or work rate has exceeded 1000 BTU/hr at any time during the preceeding hour, nor should it be performed while unduly fatigued.

It is highly desirable that at least two hours and mandatory that at least one hour intervene between eating and the performance of this experiment.

It is mandatory that a crewman participate in the M092 tests during the same part of the day for each performance, i.e., a morning run will always be finished prior to the noon eat period and an afternoon run will always be finished by the evening eat period. If his first test is done in the morning, then all subsequent tests will be done in the morning. If his first test is done in the afternoon, then all subsequent tests will be done in the afternoon.

It is desirable that M092 be followed immediately by M093 (Vector-cardiogram) or, when applicable, by M171 (Metabolic Activity) in order to reduce requirements for subject instrumentation.

Although sequential performance of M092, M093, or M171 is desirable, M092 must in all instances be the first experiment in the sequence.

The tests should be performed at an OWS ambient temperature of 67°F to 78°F at 5 psia.

Air motion in the vicinity of the equipment will be controlled from 15 fpm to 100 fpm. There is no requirement for measurement of air velocity unless an out of tolerance condition is suspected.

At least three hours should intervene from the time of a hot shower before the performance of this experiment.

A performance by each crewman will be accomplished as close to the end of the mission as possible.

One-half hour should elapse following a venipuncture before the performance of this experiment.

In-Flight Data

- a) Telemetry - Required telemetry measurements for each LBNP session will be transmitted on a real-time basis when ground coverage permits; otherwise the data will be recorded for subsequent playback and transmission. Dumps of recorded data will be initiated at least once each day that the experiment is performed.

- b) Crew Voice Comments - Comments by subject and observer will be recorded during conduct of the experiment. Voice observations will be required on the presence or absence of symptoms and/or physical signs resulting from the experiment.
 - c) Log Books - Any crew voice comments and related data which cannot be recorded on the voice recorder will be entered in the appropriate experiment log.
 - d) Photographs - None
 - e) Return Payload - Log books, if any
- For additional details, refer to Appendix A.

Evaluation

Refer to MSC-03022, Scientific Data Analysis and Reporting Plan.

Obtain electrocardiograph data in a zero-g environment.

Purpose and Background

The purpose is to measure electrocardiographic potentials in a zero-g environment.

The stresses of space flight produce changes in the cardiac function of the crewman which are reflected in electrical potential variations on the surface of the body. This experiment is designed to measure these electrocardiographic potentials of each crewman during the weightless period and the preflight and postflight periods by methods that will allow precise quantitative measurement of the changes that occur.

Vectorcardiograms (VCG's) taken on each crewman at regular intervals during space flight will be compared with VCG's taken prior to flight and postflight. Changes in the VCG patterns will be correlated with anatomical and functional changes in the heart using computer techniques for data reduction and analysis.

Functional Objectives

- Measure electrocardiographic potentials of each crewman during weightless period by methods that will allow precise quantitative measurement of the changes that occur.

F0 1) Obtain VCG's on each crewman every third day during the mission.
thru
F0 17)

Performance Requirements

a) Baseline Requirement

F0 1) VCG's will be taken on each crewman every third day (F0 1 thru
thru F0 17) during the mission. This will result in more than 17
F0 17) VCG's per crewman provided the every-third-day routine can be
maintained. It is permissible, when time constraints so dictate,
to change the three-day time interval by + one day. (Each F0
will be completed when all three crewmen have completed a
M093 performance.)

b) Minimum Scheduling Requirement

F0 1) Same as the baseline requirement
thru
F0 17)

c) Performance Redline

F0 1) Continue to schedule toward the baseline requirement.
thru
F0 17)

Performance Conditions

- FO 1) VCG's will be taken on each crewman commencing as soon as possible
 thru after Orbital Workshop (OWS) activation per procedures contained
 FO 17) in the appropriate checklist.

This experiment will not be performed for at least one hour if exercise or work rate has exceeded 1000 BTU/hr at any time during the preceeding hour, nor should it be performed while unduly fatigued.

This experiment will not be performed less than one-half hour after the motion sensitivity test of M131.

It is highly desirable that at least two hours and mandatory that at least one hour intervene between eating and performance of this experiment.

It is mandatory that a crewman participate in the M093 tests during the same part of the day for each performance, i.e., a morning run will always be finished prior to the noon eat period and an afternoon run will always be finished by the evening eat period. If his first test is done in the morning, then all subsequent tests will be done in the morning. If his first test is done in the afternoon then all subsequent tests will be done in the afternoon.

It is desirable that this experiment be performed immediately after completing M092 (In-Flight Lower Body Negative Pressure).

VCG data from eight in-flight performances of Experiment M171 by each crewman may be substituted for eight in-flight performances of M093. The M171 protocol will govern these performances.

The tests should be performed at an OWS ambient temperature of 67° to 78°F at 5 psia.

Air motion in the vicinity of the experiment will be controlled from 15 fpm to 100 fpm. There is no requirement for measurement of air velocity unless an out of tolerance condition is suspected.

A bicycle ergometer from Experiment M171 will be used by the subject for the exercise period required for the vectorcardiogram.

At least three hours should intervene from the time of a hot shower before the performance of this experiment.

A performance by each crewman will be accomplished as close to the end of the mission as possible.

One-half hour should elapse following a venipuncture before the performance of this experiment.

In-Flight Data

- a) Telemetry - Required telemetry measurements for each experiment session will be transmitted on a real-time basis when ground coverage permits; otherwise the data will be recorded for subsequent playback and transmission.

- b) Crew Voice Comments - Voice data for each experiment session will be transmitted on a real-time basis when ground coverage permits; otherwise the comments will be recorded for subsequent playback and transmission.
- c) Log Books - None
- d) Photographs - None
- e) Return Payload - None

For additional details, refer to Appendix A.

Evaluation

Refer to MSC-03022, Scientific Data Analysis and Reporting Plan.

M110 Series
(Experiments M112,
M113, M114 and M115)

HEMATOLOGY AND IMMUNOLOGY SERIES

Obtain blood samples during space-flight.

Purpose and Background

The purpose is to acquire blood samples from each of the Skylab crewmen at regular intervals during flight, and to separate and preserve these samples for postflight analyses according to the protocols of M071, M073, M112, M113, M114 and M115. (Note: Specific DTO's have not been included in this Mission Requirements document on Experiments M112 thru M115 since their total in-flight requirements are satisfied by M110.)

Analysis of in-flight blood samples is an important complement to the pre- and postflight testing done in the above experiments. The overall purpose of experiments M112 thru M115 is to evaluate changes in the biochemical composition of the constituents of blood which might result from prolonged spaceflight. The in-flight samples are necessary to determine the effects of long duration spaceflight upon man's biochemical processes; to identify and establish significant trends in these data; to differentiate the relative effects of the stresses of launch, prolonged weightlessness, and reentry; and to establish the time course of adaptive processes.

Functional Objectives

- Acquire blood samples from each crewman at regular intervals during flight.

F0 1) Collect in-flight blood samples from each crewman eight times thru during the mission. Separate the plasma and cellular phases of F0 8) the blood by centrifugation, and preserve both samples by freezing to prevent degradation of the biochemical constituents prior to postflight analyses. Preserve a portion of the first and last whole blood samples by chemical fixation.

Performance Requirements

a) Baseline Requirement

F0 1) Obtain and process sample 1 on the first day after activation of workshop (no later than day 3).
F0 2) Obtain and process sample 2 on day 5 or day 6.
F0 3) Obtain and process sample 3 on day 12(+1).
F0 4) Obtain and process sample 4 on day 19(+1).
F0 5) Obtain and process sample 5 on day 26(+1).
F0 6) Obtain and process sample 6 on day 37(+1).
F0 7) Obtain and process sample 7 on day 47(+1).
F0 8) Obtain and process sample 8 on the last day possible prior to reentry (day 54 or 55 is highly desirable).

b) Minimum Scheduling Requirement

F0 1) Same as the baseline requirement
thru
F0 8)

c) Performance Redline

F0 1) Continue to schedule toward the baseline requirement.
thru
F0 8)

Performance Conditions

F0 1) Detailed procedures for obtaining and processing in-flight blood
thru samples are contained in the appropriate checklist.

F0 8) All three crewman will participate in the blood sampling sessions.

The blood samples (of approximately 11 ml per crewmen) should be drawn in the morning shortly after rising. An eight-hour fasting period should precede the blood draw, and there should be no strenuous exercise (greater than 700 BTU/hr) for two hours preceding sample acquisition.

The blood samples in the Automatic Sample Processor (ASP) will be centrifuged in a special in-flight unit. The separated plasma/blood samples will then be removed as soon as possible after completion of the centrifuge cycle (30 minutes maximum) and frozen in designated slots of the urine return container for recovery.

On the first and last sample day, a sample of approximately 0.1 ml of blood will be injected into a fixed cell sample vial containing 1 ml of 0.5% glutaraldehyde. These fixed cell samples will be returned in the In-Flight Medical Support System return container.

In-Flight Data

- a) Telemetry - None
- b) Crew Voice Comments - Date, crewman identity, ASP serial number, and blood vial serial number
- c) Log Books - None
- d) Photographs - None
- e) Return Payload - Frozen blood samples and fixed cell samples

For additional details, refer to Experiments M071, M073, and M112 thru M115 of Appendix A.

Evaluation

Refer to MSC-03022, Scientific Data Analysis and Reporting Plan, as related to Experiments M071, M073, and M112 thru M115.

Obtain data on semicircular canal stimulation and spatial localization.

Purpose and Background

The purpose is to determine the effects of prolonged absence of gravity on an astronaut's susceptibility to Coriolis force and on his judgment of spatial localization.

Evaluation of related hypotheses includes the following significant factors:

- a) If there is no measured acute change in motion sensitivity in any of the crew, then the results would not be consistent with transient zero-g aircraft studies. In this case, these types of studies may be de-emphasized for future usefulness, but a greater need for future studies on orbiting and rotating spacecraft would be indicated.
- b) If increased susceptibility is accompanied by decreased canal threshold, then an etiological (intralabyrinthine) mechanism may be defined which would indicate the need for artificial gravity in terms of otolithic modulating activity.
- c) If there is increased susceptibility but not change in canal thresholds, then the importance of functional interaction of canals and otoliths with other physiological systems (cardiovascular, etc.) in the production of behavior decrement or malaise would be demonstrated.
- d) If there is no change in susceptibility but a definite change in canal thresholds, then insufficient time for the effect to manifest itself in whole body response or the role of compensatory mechanisms to act would be indicated.

Functional Objectives

● Determine man's adaptability to unusual vestibular conditions and to predict habitability of future spacecraft conditions involving sub-gravity and Coriolis forces.

FO 1) Perform Motion Sensitivity (MS) tests using the Rotating
thru Litter Chair (RLC) in the rotating mode to determine
FO 6) susceptibility to Coriolis forces as a function of time
in weightlessness, and measure semicircular canal
response thresholds by conducting Oculogyral Illusion
(OGI) threshold tests.

● Measure the accuracy and variability in the judgement of spatial coordinates based upon atypical gravity receptor cues and inadequate visual cues.

FO 7) Perform spatial localization tests using the Otolith Test
 thru Goggles (OTG), the rod and sphere device, and the RLC in
 FO 9) the static mode.

Performance Requirements

a) Baseline Requirement

FO 1) Six MS and OGI tests will be performed on each of two crewmen (FO 1
 thru thru FO 6) for a total of twelve tests during the mission. The
 FO 6) first MS/OGI tests will be performed no later than mission day 5.
 FO 7) The spatial localization tests will be performed on all crewmen
 thru once early (on day 3 thru 6) in the mission (FO 7), once in the
 FO 9) middle (on day 26 thru 30) of the mission (FO 8), and once late
 (on day 50 thru 56) in the mission (FO 9).

b) Minimum Scheduling Requirement

FO 1) Same as the baseline requirement
 thru
 FO 9)

c) Performance Redline

FO 1) Continue to schedule toward the baseline requirement.
 thru
 FO 9)

Performance Conditions

FO 1) The combined OGI and MS tests will be conducted no closer than
 thru every other day and will be equally time spaced where possible.

FO 6) It is highly desirable to perform the OGI test immediately prior
 to the MS test.

No MS testing shall be done until one hour after completion
 of a meal.

FO 7) Spatial localization (static) tests should not be performed on the
 thru same day as rotating (dynamic) tests. However, if it is necessary
 FO 9) to run both types of tests on the same day, then the static tests
 will precede the dynamic tests.

FO 1) Participating crewmen will perform as experiment subjects within
 thru a 16-hour period for each FO.

FO 9) All crewmen should go through the same test on any one day rather
 than mixing the tests of FO 1 thru FO 6 with the tests of FO 7
 thru FO 9.

During the second scheduled OGI experiment session and with one
 crewman only (preferably the Pilot), the camera will be started
 immediately prior to initiation of the last set of acceleration/
 deceleration profiles and stopped at the end of this set.

During the second scheduled MS experiment session (i.e., same day as OGI threshold filming) and with both the Pilot and Scientist Pilot, the camera will be started when the crewman initiates the first head movement sequence and will be stopped when the crewman reaches the Malaise IIa level.

If film is available after the above MS test, then during the second scheduled spatial localization session and with one crewman only (preferably the Commander), the camera should be started at the beginning of the litter mode at 41° and stopped at the end of the litter mode at 41°.

Finally, the remaining film, if any, will be used to photograph subsequent MS tests until film depletion.

This experiment will be performed per procedures contained in the appropriate checklist.

The Orbital Workshop (OWS) ambient temperatures for the experiment should lie within a range of 67° to 78°F at 5.0 psia.

Air motion in the vicinity of the experiment shall be controlled from 15 feet per minute to 100 feet per minute. There is no requirement for measurement of air velocity unless an out of tolerance condition is suspected.

During the performance of OGI and spatial localization tests, the vehicle will be in solar inertial attitude and momentum dumps will be inhibited.

The OWS lighting should be adequate, while the experiment is in progress, to allow the observer to recognize color changes in the subject's face and to read applicable instrumentation.

In-Flight Data

- a) Telemetry - M131 telemetry measurements will be recorded on the AM recorder for subsequent playback and transmission to the ground.
- b) Crew Voice Comments - The required comments from the participating crewman will be recorded for playback.
- c) Log Books - None. Entries will be recorded on log sheets with the checklist or on the cue card as appropriate for the specific test. Data will subsequently be voice recorded for playback.
- d) Photographs - One cassette of 16-mm color sequence photographs will be taken to document selected parts of the experiment.
- e) Return Payload - Logged data (only if voice logging was not accomplished), film, and one Otolith Test Goggle

For additional details, refer to Appendix A.

Evaluation

Refer to MSC-03022, Scientific Data Analysis and Reporting Plan.

Obtain data on sleep patterns
in a space environment.

Purpose and Background

The purpose is to objectively evaluate sleep quantity and quality during prolonged space flight.

It has been shown that subjective assessment of one's sleep quality is frequently inaccurate. A method for objectively evaluating sleep is to determine the electrical activity of the brain and the motions of the eyes during the sleep period. Onboard analysis of the electroencephalographic (EEG), electro-oculographic (EOG) activity, and near real-time telemetry of analysis results will provide an objective progressive record of sleep throughout the flight.

It has been demonstrated that disrupted patterns of sleep are associated with modified performance capability. Accurate information regarding sleep in the space environment is, therefore, of practical significance and may find useful application in future mission planning.

Functional Objectives

- Objectively evaluate sleep quantity and quality during prolonged space flight.

FO 1) Obtain EEG, EOG, and head movement data from a subject
thru continuously during a sleep period for 21 scheduled
FO 21) sleep periods.

Performance Requirements

a) Baseline Requirement

FO 1) EEG, EOG, and head movement data will be taken during 21 (FO 1
thru thru FO 21) regularly scheduled sleep periods. The flight record-
FO 21) ing of the sleep periods will be accomplished on mission days
3, 4, 5, 8, 11, 14, 17, 20, 23, 26, 29, 32, 35, 38, 41, 44, 47,
50, 52, 53 and 54.

b) Minimum Scheduling Requirement

FO 1) Same as the baseline requirement
thru
FO 21)

c) Performance Redline

FO 1) Continue to schedule toward the baseline requirement.
thru
FO 21)

Performance Conditions

FO 1) Experiment preparation and postoperation tasks will be accom-
thru plished per procedures contained in the appropriate checklist.
FO 21) Recordings will be made during the regularly scheduled sleep
periods.

In-Flight Data

- a) Telemetry - Results of the onboard sleep stage analysis will be transmitted to the ground on a near real-time basis.
- b) Crew Voice Comments - None
- c) Log Books - Astronaut log entries will be made following each monitored sleep period.
- d) Photographs - None
- e) Return Payload - Log books (if voice logging was not accomplished) and two reels of magnetic tape with sleep data

For additional details, refer to Appendix A.

Evaluation

Refer to MSC-03022, Scientific Data Analysis and Reporting Plan.

Obtain photographs of crew activity.

Purpose and Background

The purpose is to study the adaptability, mobility, fine and gross motor activities of crewmen and effects of other variables on motor activity in work and task performance during a spaceflight of up to 56 days duration.

Skylab film will produce time and motion data directly applicable to the Skylab Program and will be especially valuable for future programs. Specifically, they are pertinent to:

- a) Providing an insight into the nature of work performed in space flight, the variables affecting the time and motion patterns required to perform specific tasks, and valuable information for the design of procedures, methods, tasks and equipment for future missions.
- b) Providing supplemental pictorial information (in conjunction with planned metabolic activity, extravehicular activity, and other studies) regarding the effectiveness of restraint systems utilized and energy cost of astronaut movements.
- c) Determining the training time and level of training which will be required of astronauts to perform certain in-flight tasks, especially portions of approved experiments.
- d) Determining the training time and resource requirements which may be anticipated for ground-based training (including neutral buoyancy) and zero-g training flights for specific types of astronaut activities.
- e) Determining the time requirements for the conduct of specific types of in-flight activities and thereby provide an input to mission planning for future flights.

Functional Objectives

● Determine the effectiveness with which crewmen perform in-flight tasks when compared with the same task performed in training on earth as measured by time and motion determinants.

- F0 1) Photograph two crewmen during donning of vectorcardiogram (VCG)
thru sensors, harness and belt; translation to and from and ingress
F0 10) and egress of confined enclosures; and mounting, applying re-
straints, and operating the ergometer.
- F0 11) Photograph crew activity during the deployment and retrieval of
thru experiment hardware of large size and mass, including transla-
F0 18) tion, installation, activation, transfer from one location to
another, removal, and stowage of the hardware.
- F0 19) Photograph crew activity during the deployment and retrieval of
thru experiment hardware of medium size and mass, including translation,
F0 23) installation, activation, removal, and stowage of the hardware.
- F0 24) Photograph two crewmen during activity pertinent to donning
thru and doffing of the pressure garment assembly.
F0 26)

FO 27) Photograph crew maintenance type activities associated with
 thru experiment hardware which requires the repeated removal and
 FO 29) installation of subassemblies.

Performance Requirements

a) Baseline Requirement

FO 1) The baseline requirement is shown in the following M151 Table
 thru of Baseline Requirements.
 FO 29)

b) Minimum Scheduling Requirement

FO 1) Same as the baseline requirement
 thru
 FO 23)

FO 24) None
 thru
 FO 29)

c) Performance Redline

FO 1) Continue to schedule toward the baseline requirement.
 thru
 FO 23)

FO 24) None
 thru
 FO 29)

Performance Conditions

FO 1) The crewmen will perform and photograph activities in accordance
 thru with procedures contained in the appropriate checklist.

FO 29) A sufficient number of performances of selected crew activities
 (see following M151 Table of Baseline Requirements) will be
 photographed to provide data for study of the potential variables
 which satisfy the functional objectives of M151. If one of the
 prime photographic activities is not performed for any reason,
 the M151 Principal Investigator will be available for consul-
 tation on a real-time basis for selection of an alternate or
 contingency activity source.

During experiment operations, a voice record will be made identi-
 fying the experiment, crewmen, cassette, camera setting, and
 Greenwich Mean Time.

It is highly desirable to obtain television data that will
 supplement in-flight sequence photographs.

M151
Table of Baseline Requirements

Photographed Activity	Activity Source		Performances to be Photographed Relative to Prime Activities**	Est. Filming Time Per Performance (Min.)
	Prime	Alternate*		
F0 1) thru F0 10)	M092/M171 or M092/M093	1. M093 2. M110	10 performances of 2 crewmen 5 times each (all performances photographed at 2 frames per second)	30
F0 11) thru F0 18)	T027/S073	1. S183 2. S149	4 preparation/extension 4 retraction/stows	prep/extend 36 retract/stow 36
F0 19) thru F0 23)	S190B	1. S190A 2. S019	5 deployments or re-trievals	20
F0 24) thru F0 26)	Pre EVA Post EVA	1. M509 (Pre and Post Suited) 2. T020 (pre and Post Suited)	3 performances of 2 crewmen donning and doffing (all performances photographed at 2 frames per second)	don - 30 doff - 15
F0 27) thru F0 29)	M509	T020	3 performances of 1 crewman including 1 suited run preparation	15

*Alternates are listed in order of preference.

**All scenes will be photographed at 6 frames per second except where specified otherwise.

In-Flight Data

- a) Telemetry - None
- b) Crew Voice Comments - Date and identification of activity photographed, supply cassette identification and percent of film remaining in that cassette at end of each activity photographed, and take-up cassette identification and percent of film loaded into that cassette at end of each activity photographed.
- c) Log Books - None
- d) Photographs - Photographs as required by FO 1 thru FO 29
- e) Return Payload - 16-mm motion picture film (in a quantity equivalent to 14 cassettes)

For additional details, refer to Appendix A.

Evaluation

Refer to MSC-03022, Scientific Data Analysis and Reporting Plan.

Obtain data on man's metabolic effectiveness in zero gravity.

Purpose and Background

The purpose is to determine if man's metabolic effectiveness in doing mechanical work is progressively altered during exposure to a space environment.

A bicycle ergometer will be evaluated as an exerciser during the mission.

The metabolic rate will be measured in terms of oxygen consumption, carbon dioxide production during rest, and calibrated exercise using an ergometer. In addition, body temperature, minute volume, blood pressure, heart rate, and vectorcardiogram data will be taken. Vital capacity will be measured separately.

The entire set of measurements will be repeated throughout the mission to determine the effects due to mission duration.

In order to evaluate results obtained in flight, ground-based data will be obtained on each crewman. Additional ground-based physiological data will be obtained where practicable in separate studies, including bed rest, water immersion, reduced gravity simulators, and exercise training protocols.

Functional Objectives

- Determine if man's metabolic effectiveness in doing mechanical work is progressively altered during exposure to a space environment.

F0 1) Perform calibrated exercise (by all three crewmen) on a
thru bicycle ergometer.
F0 8)

Performance Requirements

a) Baseline Requirement

F0 1) Bicycle ergometry will be performed eight times (F0 1 thru F0 8)
thru by each crewman as a test subject for a 56-day mission. F0 1
F0 8) will be performed as close to activation as possible and F0 8
as close to end of mission as possible. The remaining F0's will
be spaced evenly throughout the mission. (Each F0 will be
completed when all three crewmen have completed a M171 performance.)

b) Minimum Scheduling Requirement

F0 1) Same as the baseline requirement
thru
F0 8)

c) Performance Redline

F0 1) Continue to schedule toward the baseline requirement.
thru
F0 8)

Performance Conditions

FO 1) Resting metabolic rate and bicycle ergometry will be conducted
thru per procedures contained in the appropriate checklist.
FO 5)

Prior to scheduling the experiment, there must be:

- a) A two-hour delay if eating is scheduled before performing the experiment
- b) A one-hour delay if exercise or work rate has exceeded 1000 BTU/hr at any time during the preceding hour

This experiment should not be performed while unduly fatigued.

It is mandatory that a crewman participate in the M171 tests during the same part of the day for each performance, i.e., a morning run will always be finished prior to the noon eat period and an afternoon run will always be finished by the evening eat period. If his first test is done in the morning, then all subsequent tests will be done in the morning. If the first test is in the afternoon, then all subsequent tests will be done in the afternoon.

During the experiment performance, the environmental gas temperature should be within the range of 67° to 78°F at 5 psia.

Air motion in the vicinity of the equipment will be controlled from 15 feet per minute to 100 feet per minute. There is no requirement for measurement of air velocity unless an out of tolerance condition is suspected.

In-Flight Data

- a) Telemetry - Experiment and supporting telemetry measurements will be transmitted in real time or near real time.
 - b) Crew Voice Comments - Comments by the subject and observer will be transmitted in real time or near real time.
 - c) Log Books - Appropriate data will be recorded on cue card for subsequent voice recording and playback.
 - d) Photographs - None
 - e) Return Payload - Log books, if voice logging was not accomplished.
- For additional details, refer to Appendix A.

Evaluation

Refer to MSC-03022, Scientific Data Analysis and Reporting Plan.

Measure body mass in zero gravity.

Purpose and Background

The purposes are to demonstrate accurate nongravimetric measurement in spaceflight, to validate and explore limits of the spring/mass oscillator method of mass measurement, and to support biomedical experiments requiring mass measurements.

Known calibrated masses will be used to establish a calibration under weightless conditions, which will necessarily be different from one-g calibration. This will allow comparison of unknown to known masses.

Functional Objectives

- Demonstrate body mass measurement without gravity and also validate theoretical behaviors of the device.

F0 1) Perform BMMD calibration validations using preflight
thru calibrated masses from 0 to 100 kilograms.
F0 3)

Performance Requirements

a) Baseline Requirement

F0 1) Calibration measurements will be made as soon as possible after
thru Orbital Assembly activation (F0 1), and every 24 (+2) days there-
F0 3) after (F0 2 and F0 3) for a total of three performances.

b) Minimum Scheduling Requirement

F0 1) Same as the baseline requirement
thru
F0 3)

c) Performance Redline

F0 1) Continue to schedule toward the baseline requirement.
thru
F0 3)

Performance Conditions

F0 1) Calibration validation will be per procedures contained in the
thru appropriate checklist.

F0 3) The measurement of each mass during calibration or operation
will be repeated five times.

During performance of this experiment, the vehicle will be in solar inertial attitude and momentum dumps will be inhibited. Any measurements made during inadvertent shocks or accelerations will be repeated.

Calibrated masses to be used are stowed items, and are identified in the appropriate checklist.

In-Flight Data

- a) Telemetry - None
- b) Crew Voice Comments - Calibration data [calibration time for each mass, Greenwich Mean Time (GMT), BMMD temperature, and mass identification] will be transmitted by voice to ground. Calibration data will be made available to the PI within 48 hours after each calibration sequence.

Comments will be made on the operation of the BMMD.

- c) Log Books - Calibration data (calibration time, GMT, BMMD temperature, and mass identification) will be logged.
- d) Photographs - None
- e) Return Payload - Log books

For additional details, refer to Appendix A.

Evaluation

Refer to MSC-03022, Scientific Data Analysis and Reporting Plan.

3.2.2 Apollo Telescope Mount Experiments

There are six Apollo Telescope Mount (ATM) experiments. They are:

S052	White Light Coronagraph
S054	X-Ray Spectrographic Telescope
S055A	Ultraviolet Scanning Polychromator-Spectroheliometer
S056	Extreme Ultraviolet and X-Ray Telescope
S082A	Coronal Extreme Ultraviolet Spectroheliograph
S082B	Chromospheric Extreme Ultraviolet Spectrograph

These ATM sections present a joint experiment approach to the definition of the ATM experiment requirements. These requirements are described in the following sections where the relationships between Joint Observing Programs (JOP), Scientific Objectives, Operational Constraints, Building Blocks (BB), and Skylab Program scheduling guidelines are presented.

3.2.2.1 ATM Joint Observations

a) ATM Viewing Time

The candidate JOP's for the ATM Principal Investigator Group selection on Mission SL-3 are presented in Section 3.2.2.4. This selection will depend upon the solar behavior, film consumable status and final ATM viewing period selection consistent with the flight planning guidelines of Section 2 (described below for ATM). The ATM Principal Investigator Group will have wide latitude to make JOP selections so that scientific yield from the ATM solar observations may be optimized. The limits placed on this selection latitude are described in Section 3.2.2.1(c).

The flight planning guidelines for ATM are described as follows:

Crew-attended ATM operations shall be given scheduling priority for one crewman, exclusive of those periods allocated to EREP, for all daylight passes (plus the necessary night periods) for all identified experiment days. The ATM scheduling objective shall be 205 daylight hours, excluding ATM checkout, above the 400-km observing constraint defined in Section 3.2.2.1(d)2. Any additional ATM viewing time that is available, due to the ATM scheduling priority stated above, will be allocated and used for ATM observations in the same manner as the 205 hours. Reduced scheduling guidelines (i.e., performance redlines) for real-time contingency flight planning are contained in paragraph 2.3.4.2.4(b).

Crew-attended operations shall be scheduled for a maximum of 8 orbital night passes for performance of JOP-13. The scheduling of JOP-13 maneuvers shall not interfere with operational requirements of corollary experiments.

JOP-7 and JOP-13 are to be performed with no additional mission time allocation to ATM.

ATM will be given top scheduling priority on the first three daylight passes after 1200 hours, Central Daylight Savings Time on August 7, 1973, for the purpose of experiment calibration with the Harvard College Observatory (HCO) calibration rocket. Alternate calibration rocket launch dates will be negotiated during the daily flight planning session; these alternate launch dates are anticipated to be August 9 and August 11, 1973.

ATM will be given top scheduling priority during the last four manned daylight passes on August 14, 1973, for the purpose of experiment calibration with the Naval Research Laboratory (NRL) calibration rocket launch. Alternate calibration rocket launch dates will be negotiated during the daily flight planning session; these alternate launch dates are anticipated to be August 16 and August 18, 1973.

b) Joint Observing Programs

Currently 17 JOP's have been identified and appear in Section 3.2.2.4. They are:

ATM JOP-1	Study of the Chromospheric Network and its Coronal Extension
ATM JOP-2	Active Regions
ATM JOP-3	Flares
ATM JOP-4	Prominences and Filaments
ATM JOP-5	Limb Profile Studies
ATM JOP-6	Synoptic Observations of the Sun
ATM JOP-7	Atmospheric Extinction
ATM JOP-8	Coronal Transients
ATM JOP-9	Solar Wind
ATM JOP-10	Lunar Libration Clouds
ATM JOP-11	Chromospheric Oscillations and Heating
ATM JOP-12	Program Calibration
ATM JOP-13	Observations of Night Sky Objects
ATM JOP-14	Solar Eclipse
ATM JOP-15	Coronal Holes
ATM JOP-16	Disk Transients
ATM JOP-17	Coronal Bright Spot

c) ATM Principal Investigator Participation

The ATM PI group will be allowed maximum flexibility in the selection of daily ATM viewing schedules. For nominal experiment operation PI changes in established observing programs will be limited to the following:

- 1) An experiment or a particular mode for an experiment may be deleted from a BB.
- 2) A BB may be truncated or entered at the points indicated on the BB.
- 3) The last operational mode for each experiment in a BB can be extended to any desired time within the allocated ATM time.

- 4) Prime pointing assignment (targets) for BB's can be modified.
- 5) A single experiment operational mode can be run for filler purposes.
- 6) Occasionally, the PI's will schedule a BB in a JOP even though that BB is not listed for that JOP in the MRD. This provision is to be used very infrequently.

Although the above changes do not require FOMR approval, the FOMR will be kept informed of all changes made in the preplanned observing program.

Other ATM schedule or procedure changes that do not fit into any of the above six categories must be processed through the Mission Control Team before an ATM schedule request will be implemented. In addition, the following changes will require FOMR approval prior to implementation.

- 1) New JOP's
- 2) Changes to flare alarm guidelines for unattended ATM operations (Section 3.2.2.2.f)
- 3) Changes to the allocated ATM time blocks that could impact other Skylab operations
- 4) Any changes that would violate the flight planning guidelines of paragraph 3.2.2.1(a)

In all cases, an ATM PI czar decision is required before implementation of an ATM schedule request. The ATM schedule must be submitted prior to the deadline for daily crew update messages. Authorized changes shall be uplinked whenever possible.

d) Joint Observing Programs/Building Blocks - Manned

Each ATM JOP (except JOP 14) calls for the performance of certain manned BB's presented in Section 3.2.2.5. An explanatory example of a BB is presented in Figure 3-1.

Certain operating conditions affect or constrain the performance of the manned BB's. They are:

- 1) Pre-pass preparations must be complete.
- 2) Atmospheric interference constraints must be satisfied. Unless otherwise stated in the JOP, all planning and scheduling will reflect that the minimum height above the earth of the ATM sun line-of-sight is 400 km. In addition, the performance of certain fill-in operations is desired on both ends of each viewing pass. The fill-in operations will depend on such factors as solar conditions and the amount of film remaining, and therefore, will be scheduled by the ATM PI's during the mission on an as-required basis.

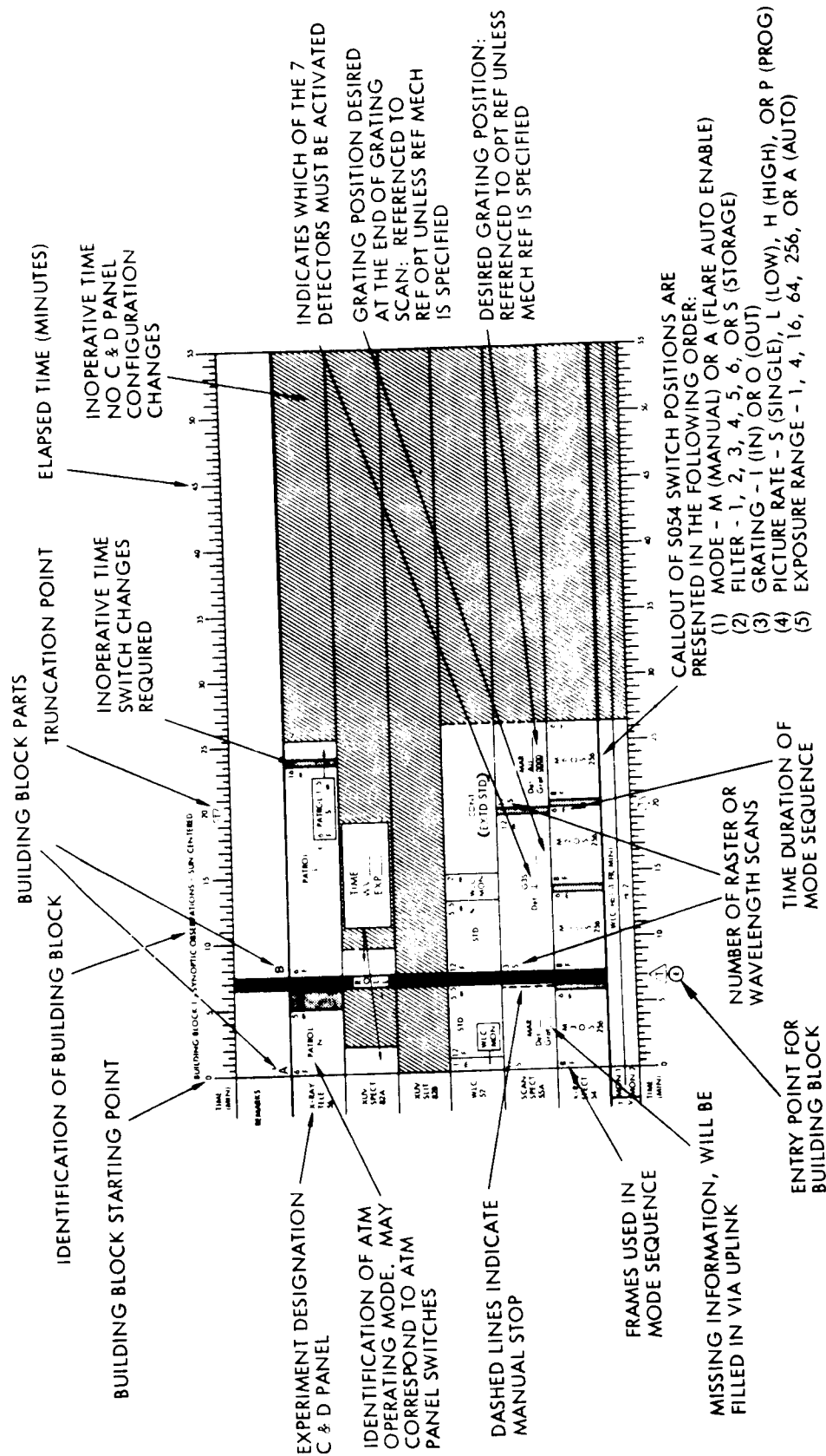


Figure 3-1. Sample Manned Building Block with Explanations

- 3) Nominal frame rates for H α 1 camera are to be determined as follows:

Quiet sun JOP's	1 frame/minute
Active sun JOP's	2 frames/minute
Transient events or flare JOP's	4 frames/minute

The frame rates shown on the BB's indicate the usual frame rate for that BB and should be revised by the crewmen when in conflict. Changes to the above frame rates may be made during the mission depending on the H α 1 film utilization.

e) Repetitions of Joint Observing Programs

The following numbers represent a preliminary assessment of the number of repetitions of each JOP for the SL-3 mission. The actual number of repetitions will be dependent upon solar conditions.

<u>JOP</u>	<u>Parts</u>	<u>No. of Repetitions Desired</u>
JOP-1	A	2
	B	2
	C	4
	D	2
	E	3
	F	1
JOP-2	A	60 Hrs.
	B	3
	C	3
	D	20 Hrs.
	E	2
	F	3
	G	1 Hr.
JOP-3	A	N/A Flare Dependent
	B	N/A Flare Dependent
JOP-4	A	4
	B	4
	C	4
JOP-5	A	2
	B-a)	2
	B-b)	1
	C	9
JOP-6		1
JOP-7		1
JOP-8	A	N/A Solar Activity Dependent
	B	N/A Solar Activity Dependent
	C	N/A Solar Activity Dependent
	D	N/A Solar Activity Dependent

<u>JOP</u>	<u>Parts</u>	<u>No. of Repetitions Desired</u>
JOP-9		1
JOP-10		2
JOP-11	A	4
	B	2
JOP-12	A	1
	B	1
	C	1
	D	1
	E	1
	F	Once every other day
JOP-13		8
JOP-14	A	1 (Unmanned)
	B	1 (Unmanned)
JOP-15	A	1
	B	1
	C	1
	D	1
JOP-16		N/A Solar Activity Dependent
JOP-17	A	2
	B	2
	C	2
	D	2

f) Priority of Joint Observing Programs

The relative priority and scheduling guidelines of each JOP group are presented below. JOP-12, A, B, and C defined below, have top priority. When solar conditions are favorable, the JOP's in the Solar Activity Group have the next highest priority; otherwise, the JOP's of Group A will have a higher priority than those of Group B.

<u>Program</u>	<u>Solar Activity</u>	<u>Group A</u>	<u>Group B</u>
<u>Calibration</u>	<u>Group</u>		
JOP-12	JOP-3	JOP-1	JOP-7
A	JOP-8	JOP-2	JOP-10
B	JOP-16	JOP-4	JOP-13
C		JOP-5	
		JOP-6	
		JOP-9	
		JOP-11	
		JOP-12D, E & F	
		JOP-15	
		JOP-17	

NOTE: JOP-14 has the highest priority for unmanned operations.

The crewman will interrupt the scheduled observing programs and substitute JOP-3, JOP-8 or JOP-16 as appropriate. However, JOP-12A and JOP-12B are not to be interrupted for any reason; S052 is not to be interrupted while performing JOP-12C at the beginning and end of each film canister, i.e., the first and last 144 frames; nor is S054 to be interrupted while performing part C of JOP-12 at the end of each film canister, i.e., the last 102 frames. Interruptions may be based upon notification from the ground and/or upon the judgement of the ATM operator consistent with JOP requirements and daily flare/coronal transient region guidelines from the ATM PI czar.

g) Cross-Reference Table

A summary of the ATM experiment BB-usage by JOP's is presented in Table 3-2.

3.2.2.2 Other ATM Requirements

a) Unattended Observing Program

The unattended ATM observing programs will make use of the time during the Skylab Mission when the crewmen are aboard but unavailable for ATM operations. The JOP data obtained during these periods is somewhat incomplete since some of the experiments cannot be operated by ground command. However, for those experiments which can be operated, the data obtained will be acceptable and can be used to help meet the scientific objectives of the JOP for which it was obtained. Unattended observations will be scheduled by the ATM PI's during the mission in the same fashion and at the same time as the manned observations.

The ATM experiments that will normally operate during the unattended periods are S052, S054 and S055A. In addition S082A may sometimes operate if film limitations permit. The individual PI's will have the option of not participating in any given building block operation.

Each day, a minimum of 75 percent of the unattended solar inertial orbits shall be made available to meet the detailed unattended observing requirements included in the JOP descriptions.

Ground station coverage is required for purposes of transmitting the uplink commands to initiate all of the experiments during the unattended periods. Experiments S052, S054, and S082A will automatically stop at the end of the sequence of the selected mode; Experiment S055A, unless inhibited, will automatically start and operate on crossing the sunrise terminator provided that the last selected mode was a mirror or grating mode. All experiments except S054 will be stopped automatically on crossing the sunset terminator.

b) Unmanned Observing Program

The unmanned ATM observing programs will make use of the time from ATM deactivation at the end of SL-2 to ATM activation on SL-3. As in the case of unattended observing programs, the JOP data obtained during these periods are somewhat incomplete since some of the experi-

Table 3-2. ATM Building Block Usage Summary

ATM JOP NO.	BUILDING BLOCK																												
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
1	○	○	○			M	M			M	M		M					M	M				M				M		
2	○	○	○	○		M	M			M			M	M					M				M	M					
3	○	○			○	○	○	[M]	[M]	○																			
4	○	○	○			M					M			M														M	
5	○	○	○			M					M		M										M						M
6	○	○	○	○	○	○	○	[]	[]	○	○	○	○	○														M	
7															M														
8	○			○						M						M	M								M				
9	○	○	M																										
10	○	○	M															M											
11	○	○		○				[]		M	○	○	○					M											
12	○	○	○	○	○	○	○			M	M		M			M					M	M	M			M			
13																				M									
14	○	○	○	○	○	○	○			○	○	○	○	○														M	
15		○	M			M				M	M		M						M				M						
16																													
17			M			M					M																		

M - Manned
 [] - Unattended
 ○ - Unmanned

ments cannot be operated by ground command, since experiment roll is uncontrolled and since there are some instrument operating modes for S052, S054 and S055A which can not be operated in the unmanned mode. However, for those experiments which can operate, the data are acceptable and can be used to meet the scientific objectives of the JOP for which it was obtained. Unmanned observations will be scheduled by the ATM PI's on a daily basis during the mission.

The ATM experiments that can operate during the unmanned period are S052, S054, and S055A. Note that the main difference in the operational capability between unmanned and unattended operations is the inability to make daily changes to the ATM C&D panel during the unmanned period. For this reason S054 will only operate in the 256 second exposure range with command capability for filter 1, 2, or 3 and S055A cannot operate in the MLS mode. Of the 14 building blocks described in section 3.2.2.6, BB's U8 and U9 cannot be operated during the unmanned period.

A minimum of 12 hours per day shall be made available for active pointing ATM operations during the unmanned period except on those days when either ATM or OWS simulations are being conducted. The 12 hours per day period will be used to meet the detailed unmanned ATM observing requirements included in the JOP descriptions and must be scheduled such that the 12 + 2 hour scheduling requirement of ATM JOP 6 is satisfied. On those days, when ATM or OWS simulations are being conducted, two periods of unmanned active pointing ATM operations will be scheduled such that the synoptic observation requirements of ATM JOP 6 will still be satisfied. It is highly desirable that unmanned active pointing ATM operations be scheduled to include the 5:30 PM to 9:30 PM CDT period to allow simultaneous observations by the Culgoora, Australia solar observatory. In addition to the active pointing ATM operation requirements specified above, S055A will be permitted to operate in a fixed pointing mode during the remainder of the day if the S055A Principal Investigator so desires.

An exception to the 12 hours per day requirement is that on June 30, 1973, it is required to operate the ATM on nine consecutive orbits. The fifth orbit is to be the orbit in which the majority of the eclipse occurs; (approximately 11:30 GMT) therefore, ATM or OWS simulations are not to be scheduled during this time period.

Ground station coverage is required for purposes of transmitting the uplink commands to initiate the experiments during the unmanned period. Two ground station passes per daylight orbit are desired during the active pointing unmanned ATM operation periods; however, one ground station pass per daylight orbit is acceptable. Experiments S052 and S054 will automatically stop at the end of the sequence of the selected mode; Experiment S055A, unless inhibited, will automatically start and operate on crossing the sunrise terminator provided that the last selected mode was a mirror or grating mode. All experiments except S054 will be stopped automatically on crossing the sunset terminator.

c) Unattended/Unmanned Observations

The unattended/unmanned building blocks are included in Section 3.2.2.6.

d) Filler Programs

The following may be used as filler programs in cases where the entire ATM orbit is not utilized. Each of the BB's is associated with the JOP's indicated in Table 3-2 and provides supplemental data for those programs.

BB No.

2
11
6A and 6B
10
7
S082B, H α and S055A Co-Alignment
TV Downlink (Section 3.2.2.2, e)
S052, D4 calibration

e) Downlink Television

The ATM television data are used to satisfy both the near real-time mission planning needs and scientific objectives. Data may be obtained either by direct transmission (real time) or by delayed transmission (via the onboard video recorder) to a STDN station.

The crewman shall record GMT on the voice intercommunications Channel B each time the video recorder is used to record ATM television data.

The TV requirements are described in the following paragraphs 1 through 7 subject to the implementation limitations of paragraph 8.

- 1) Daily operations: Perform one ATM-TV data cycle every manned ATM day. These data will be returned to MMC-H once per day.
Each data cycle shall consist of a 15 second XUV MON normal sequence, an XUV MON integration sequence and 15 seconds each, of H α 1, H α 2, and WLC. The XUV MON normal sequence will incorporate the optimum gain setting from SL-2, and the integration sequence will make use of the optimum integration time from SL-2 (10 seconds, maximum) with a minimum acceptable number of repetitions (8 maximum). The gain setting will be the same as for the XUV MON normal sequence. The WLC TV operation will not interrupt a data taking sequence of S052.
- 2) JRL calibration rocket (JOP-12B): Perform one of the ATM-TV data cycles as soon as possible during the 4 orbit calibration sequence. These data will be used for postmission evaluation.
- 3) Additional XUV MON: Each day the PI group will be permitted to select STDN station contact times for the potential performance of additional XUV MON TV downlink operations by

the crewman (once per day, maximum) provided that such operations do not interfere with any other planned use of the CSM USB/FM link. The collection of these TV data shall also not interfere with any other crew operations or crew display requirements at the ATM C and D panel. The following plan describes the method to be adopted to accomplish this result.

- i) On STDN station passes scheduled for this operation, the appropriate station will record all TV data for the full period of station contact.
 - ii) The onboard system will be set such that the XUV MON is selected on the same monitor that is selected for CSM USB/FM downlink.
 - iii) Once station acquisition has been achieved, the ATM crewman will be notified via voice link from the ground that the network is ready to accept XUV MON data at his convenience during the next ____ minutes of station contact.
 - iv) The crewman will then perform the 15 second XUV MON normal sequence, XUV MON integration length sequence and, if possible, the $H\alpha$ sequence portion of the data cycle described in (2) on a non-interference basis with any other crew operations or crew display requirements at the ATM C and D panel.
- 4) Unattended XUV MON: Each day the PI group will be permitted to select STDN station contact times for the performance of ground commanded XUV MON TV downlink operations provided that such operations do not interfere with any other planned uses of the CSM USB/FM link. The crewman will be notified, via an update PAD, each time that he should leave the XUV MON TV system enabled for ground activation during the unattended period.
- On STDN station passes scheduled for this operation, the appropriate station will activate the Skylab TV system and record all TV data for the full period of station contact.
- 5) XUV SLIT downlink: Several times during the mission, XUV SLIT data are required for ATM pointing stability tests. The observation time will be selected by the PI group and included as a part of the daily ATM schedule.
 - 6) WLC D4 Calibration: The WLC D4 Calibration check will be performed a minimum of three times during the mission. Each performance shall include one minute, maximum, of either real time or recorded WLC TV downlink. The calibration will be scheduled as part of the daily ATM schedule.

7) Flare Wait XUV MON television: The Video Tape Recorder (VTR) will be required to collect XUV MON data during specified flare wait periods as described in JOP 2A(e). Use of the VTR for this purpose will be negotiated during the summary flight planning period.

8) Limitations on the implementation of these requirements are:

- i) Use of the onboard television system for ATM will be on a non-interference basis with the Skylab Video Documentation Project (SVDP) requirements in paragraph 2.3.8.
- ii) The video transmission schedule to MCC-H from STDN stations will be based on requirements of the SVDP.
- iii) The STDN video recorders require a minimum of 15 seconds of onboard ATM video signal prior to any ATM TV data taking sequence.

f) Flare Alarm Guidelines

The ATM flare alarm system will be activated during all solar inertial orbits of each crew day as long as the background flux is not expected to exceed 10 protons/cm²-second at energies greater than 5 Mev. Therefore, the flare alarm system should be activated as soon as possible after the crew awakes each morning and deactivated as late as possible each evening.

g) WLC Back-up Pointing Error System

Cross correlation of the TM and C&D panel readout for the Fine Sun Sensor (FSS) wedge angle shall be performed three times during the mission, once early and twice evenly spaced throughout the remainder of the mission. This cross correlation will be used to assist the ground in providing a back-up pointing system in case of a malfunction of either the FSS or the S052 Pointing Reference Subsystem.

h) Unmanned Close-out

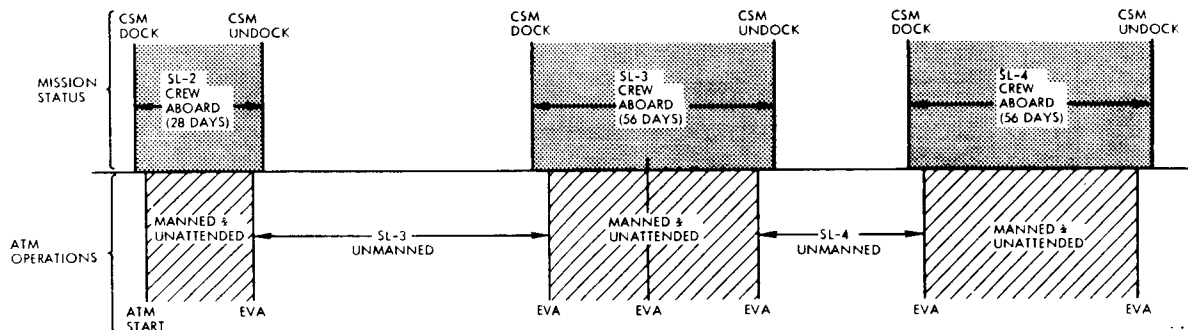
The SL-3 ATM C&D panel close-out requirements necessary to prepare the ATM for SL-4 unmanned operations are included below. The ATM experiments that will operate during the unmanned period are S052, S054, and S055A.

- 1) Experiment S052 shall be left in STD mode selection such that STD or FAST SCAN operating modes can be selected and the experiment can be operated by ground command.
- 2) Experiment S055A shall be left in the STOP mode selection such that AUTO RASTER, AUTO SCAN, REF and SINGLE STEP operating modes can be selected and the experiment can be operated by ground command. The grating should be left in the polychromatic position.
- 3) Experiment S054 shall be left in the MANUAL, STORAGE, OUT, SINGLE, 256 configuration such that filters 1, 2, or 3 can be selected and the experiment can be operated by ground command.
- 4) Roll coordinates are to be specified by the ATM PI's prior to closeout from the ground.

3.2.2.3 Implementation Guidelines

a) Manned, Unmanned, and Unattended ATM Operating Periods

The following graphical presentation depicts the ATM operating periods and defines their relationship to the Skylab Program events. Note that the basic distinction between the manned and the unattended ATM operating periods is the availability of a crewman at the ATM console for the manned period.



b) Guidelines for ATM Manned Operations

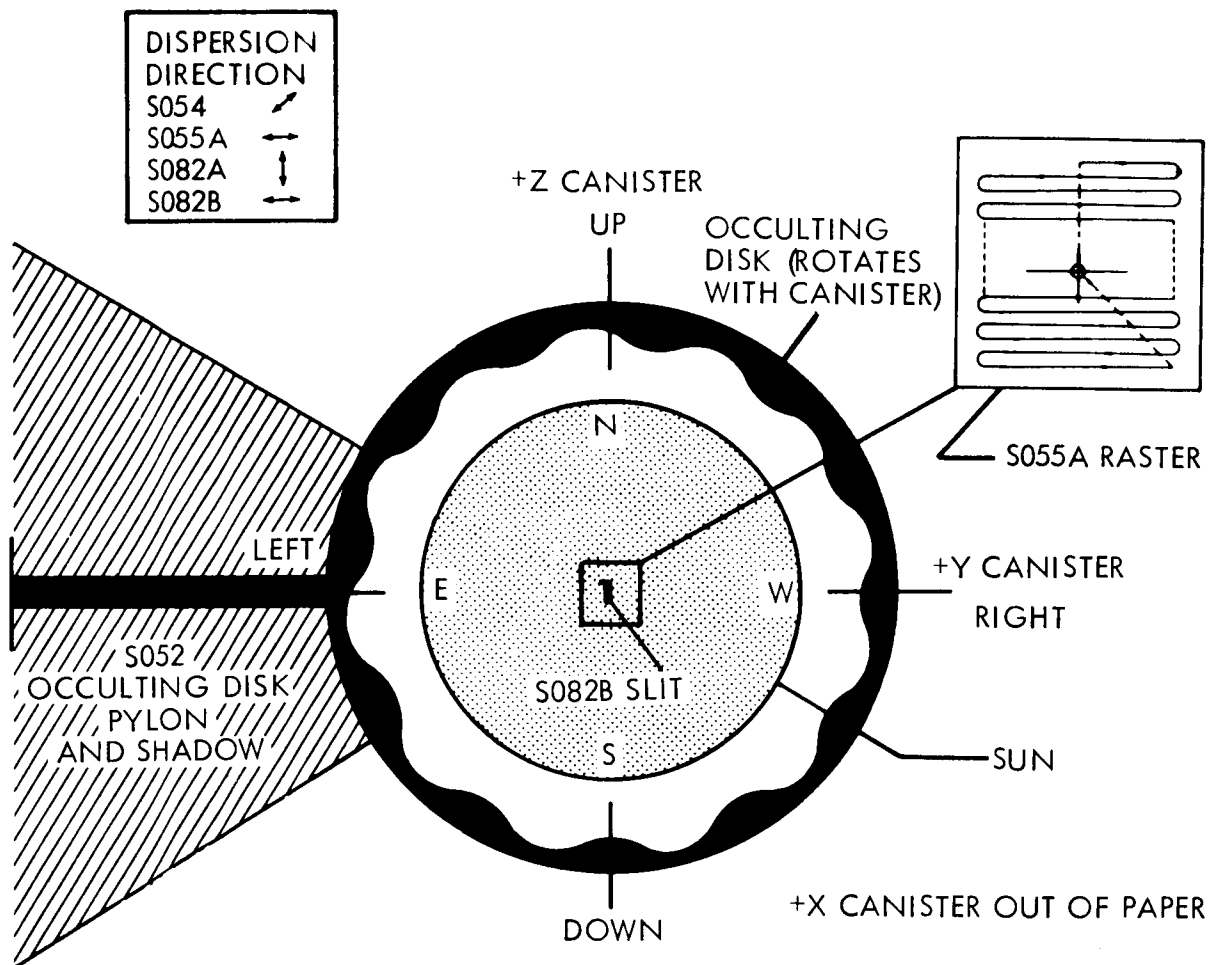
Except for ATM operator changes, only one crewman is required at the ATM C&D console for operation of all ATM building blocks. For ATM operator changes, the overlap period shall be sufficiently long to maintain continuity in the joint observing programs.

c) Pointing

Attitude requirements specified in the JOP's describe the angular relationship between the ATM canister coordinate system and the solar disk coordinates or features. Pointing at the sun center constitutes zero pitch and yaw while zero roll alignment exists when canister pitch up is to the solar north. This zero or reference position for pitch, yaw, and roll is illustrated in the following figure. The ATM C&D panel nomenclature (up, down, left, right) is also shown along with experiment references.

In terms of the C&D panel monitors the relative position of the ATM canister and the solar disk may be read on the FSS UP/DN (ARC SEC), FSS L/R (ARC SEC), and EXP ROLL (ARC MIN) counter readouts. These readings correspond to pitch, yaw, and roll, respectively. Positive roll rotates the solar image clockwise, e.g. + 5400 brings W to + Z (See Figure 3-2).

In some cases the experiment roll requirements described in this section are expressed in terms of EXP ROLL display readings on the ATM C&D panel. This counter provides a display, in arc minutes, of the experiment roll angle, γ_{RR} , which is the angle between solar north and the FSS "up" projections as seen in the plane of the solar disk. In terms of the C&D panel monitors, and the solar disk orientation, the EXP ROLL display readings of +0000, +5400, +009) 800 and -5400 correspond to a pointing of the solar north pole parallel to the TV monitor cross hair in the direction of up, left, down and right, respectively.



Schematic, looking at the C&D monitor and at the actual and displayed sun. R=0000.

Figure 3-2. ATM C&D Monitor Schematic

The ATM PI's and/or astronauts will select a target (sun centered, prominence, filament, plage, sunspot, etc.). Once a target has been selected, the ATM must be pointed so that the target is within the field-of-view of all operating instruments taking into account solar rotation and furthermore, that the instruments with small fields-of-view are pointing at the appropriate fine spatial detail in the target. This means that, in general, (of the experiments turned on and operating) the experiment with the smallest field-of-view (S055A and/or S082B) or most critical pointing requirements (S052 when sun centered) controls the fine pointing. Roll control is determined during detail flight planning periods and will be uplinked on update pad. Since S055A has several different fields-of-view, the designation of the pointing priorities for the instruments divides into three priority schemes dependent on the S055A mode of operation. These are given below. Whenever an experiment is turned off, control of the fine pointing shifts to the next experiment on the list. Experiments on the same horizontal line have equal priority.

A. When S055A is in the raster mode.

S052
S082B
S055A
S054, S056, S082A

B. When S055A is line scanning.

S052
S082B, S055A
S054, S056, S082A

C. When S055A is grating scanning.

S052
S055A, S082B
S054, S056, S082A

d) Coalignment

Coalignment of the H-Alpha 1 and H-Alpha 2 reticles with the S055A and S082B apertures ensures that a solar feature centered on the reticles actually falls within the field-of-view of the apertures at the time it is observed. The coalignment of the instruments will be maintained throughout the mission.

Either of two coalignment procedures will be scheduled by the ATM PI's: one which requires pointing the ATM to the upper and left limbs, and a longer procedure which requires pointing to all four limbs. Both procedures effect coalignment to the same precision, but the four-limb procedure is required to enter an S082B FSS BIAS into the ATMDc and to evaluate the residual offset of the S055A aperture. The astronaut will log the coalignment data and make a voice report during a subsequent ground station pass.

The following sequence of operations will be performed:

During ATM Checkout:

To remove initial misalignments, perform a four-limb coalignment.

Additional Coalignmentments

The ATM PI's will schedule additional coalignment operations along with other ATM operations on the basis of the alignment drift characteristics, the pointing precision required by each JOP, and any off-nominal condition which might alter the established coalignment.

e) ATM Operating Modes

The ATM requirements described in the JOP's ultimately call for the operation of the several instruments in certain data taking modes. These operating modes appear in each BB as indicated in Figure 3-1. Each of these modes is described below to the extent necessary to indicate what instrument sequence is intended by the information contained in the BB. Mode abbreviations used in the BB's appear in parentheses next to the mode name below.

<u>Instrument</u>	<u>Mode</u>	<u>Remarks</u>
S052	STD	Programmed sequence
	EXTD STD	Programmed sequence
	CONT	Programmed sequence with manual stop
	FAST SCAN	Programmed sequence
	SEC PROG	Programmed sequence with manual stop
S054	MANUAL (M)	Programmed sequence with FLARE AUTO switch in the INHIBIT position. The positions of GRATING, PICTURE RATE, EXPOSURE RANGE and FILTER switches are necessary to describe the desired operation.
	FLARE AUTO (FA)	Programmed sequence with FLARE AUTO switch in the ENABLE position. The positions of GRATING, PICTURE RATE, EXPOSURE RANGE, and FILTER switches are necessary to describe the desired operation.
S055A	MIRROR AUTO RASTER (MAR)	Programmed sequence with manual stop. The desired grating position and detectors must be specified.
	MIRROR 3 RASTER (M3R)	Same as MIRROR AUTO RASTER except automatic stop after 3 raster scans.
	MIRROR LINE SCAN (MLS)	Programmed sequence with manual stop. The desired line, grating position, and detectors must be specified.
	GRATING AUTO (GAS)	Programmed sequence with manual stop. The desired mirror position and detectors must be specified.
	GRATING 3 SCAN (G3S)	Same as GRATING AUTO SCAN except automatic stop after 3 grating scans.

<u>Instrument</u>	<u>Mode</u>	<u>Remarks</u>
	STOP	Continuous data-taking sequence. The desired mirror and grating position and detectors must be specified.
	GRATING REF (REF)	Same as GRATING AUTO SCAN except grating will stop at reference position.
	GRATING SINGLE STEP (GSS)	Same as STOP except the initial grating position and frequency of steps must be specified.
S056	SINGLE FR 1 (SF 1) thru SINGLE FR 6 (SF 6)	Single exposure sequence. The position of EXPOSURE switch is necessary to describe the desired operation.
	PATROL	Programmed sequence. The position of EXPOSURE switch is necessary to describe the desired operation.
	PATROL	Programmed sequence. The position of EXPOSURE switch is necessary to describe the desired operation.
	ACT 1 thru ACT 3	Programmed sequence. The position of EXPOSURE switch is necessary to describe the desired operation.
	AUTO	Programmed sequence that cycles through ACT 1, ACT 2, and ACT 3. The position of EXPOSURE switch is necessary to describe the desired position.
S082A	AUTO 1	Programmed sequence. The position of WAVE LTH and EXPOSURE switches are necessary to describe the desired operation.
	AUTO 2	Programmed sequence. The position of EXPOSURE switch is necessary to describe the desired operation.
	TIME	Manual, single frame sequence. The position of WAVE LTH and the desired exposure duration are necessary to describe the operation.
	FLARE	Programmed sequence
S082B	AUTO	Programmed sequence of varying duration depending on target zone.
	AUTO STEP	Programmed sequence

<u>Instrument</u>	<u>Mode</u>	<u>Remarks</u>
H α 1	TIME	Manual, single frame sequence. The position of WAVE LTH and the desired EXPOSURE duration are necessary to describe the operation.
	FLARE	Programmed sequence
	AUTO	Programmed continuous operation. The position of H α 1 FR/MIN is necessary to describe the desired operation.
	MAN	Manual continuous high frame rate sequence while holding switch depressed. Duration of high frame rate operation must be specified.

Section 3.2.2.4

Joint Observing Programs

Purpose and Background

Performance of the operations specified in this JOP will provide data to support:

- a) The investigation of the three dimensional structure of the chromospheric network.
- b) A study of the network in the spectral lines and continua formed in the chromosphere and chromospheric-coronal transition region.
- c) A search for the network in the high excitation lines of the XUV and X-ray portions of the spectrum.
- d) A determination of the radial velocity of material at several levels by the shift of selected spectral lines.
- e) Studies of the variation of network structure with time.

Scientific Objectives

- JOP 1A) Investigate network structure on the disk.
 JOP 1B) Investigate network structure within 2 arc minutes of the limb.
 JOP 1C) Investigate network structure at the limb.
 JOP 1D) Investigate long term evolution in the network.
 JOP 1E) Investigate short term evolution in the network.
 JOP 1F) Study spicules at the limb.

Manned Scheduling Guidelines

- JOP 1A) Network regions near the center of the sun, approximately 2
 thru arc minutes from the limb, and crossing the limb will be
 JOP 1F) selected by the Principal Investigators and/or the astronauts.
 Selection will be based upon, but not be limited to, the
 degree of definition and brightness of the network in $H\alpha$ or
 $Ca II K$, and the distance from nearby centers of activity.

In order to use S082B it is desirable that cells having a nearly straight boundary not less than 1 arc minute long be chosen, and that S082B be rolled so that the slit can be placed on this boundary. Otherwise, S082A dispersion considerations will determine the canister roll.

Coalignment is assumed between S055A, S082B and $H\alpha$, for each performance of this JOP.

- JOP 1A) Network structure on the disk

Network structure near sun center (within $0.5 R_{\odot}$) will be investigated.

JOP 1B) Network structure within 2 arc minutes of the limb

Network structure within 2 arc minutes of the limb will be investigated.

JOP 1A) During Three Consecutive Orbits:

JOP 1B)

- a) Point the ATM at the cell boundary, maximize detector No. 1 or 3, roll the S082B slit parallel to the boundary and perform Building Block 11 (BB-11). If at all possible, the boundary will be selected so that the roll is also compatible for S082A.
- b) Maintain the same roll orientation as in (a), step the ATM 10 arc seconds away from the best defined cell boundary and perform BB-6.
- c) Maintain the same roll orientation as in (a), step the ATM 5 arc seconds back toward the boundary and perform BB-11.
- d) Maintain the same roll orientation, as in (a), step the ATM approximately 5 arc seconds back to the cell boundary, maximize detector No. 1 or 3, and perform BB-6A.
- e) Maintain the same roll orientation as in (a), step the ATM 5 additional arc seconds across the cell and perform BB-11.
- f) Maintain the same roll orientation as in (a), step the ATM 5 additional arc seconds across the cell and perform BB-6A.
- g) Maintain the same roll orientation as in (a), step the ATM 5 additional arc seconds across the cell and perform BB-11.
- h) Maintain the same roll orientation as in (a), step the ATM 5 additional arc seconds across the cell and perform BB-6A.
- i) Maintain the same roll orientation as in (a), step the ATM 5 additional arc seconds across the cell and perform BB-11.
- j) Point the ATM 5 additional arc seconds across the cell, roll the S082A dispersion optimal for the cell and perform BB-3.

JOP 1C) Network structure at the limb

Point the ATM at a position defined on the update PAD or at a position on the limb where the spicules are undisturbed by active regions and roll the S082B slit parallel to the limb. Then perform a truncated BB-13 or BB-23 (two orbits only).

JOP 1D) Long term evolution in the network

A region, with a bright network, slightly east of the disk center will be selected for viewing. Point the ATM along a dark network boundary with S082B controlling the roll orientation, maximize detector No. 1 or 3 and perform BB-3 nine times. If the first orbit during which BB-3 is performed is designated as N, then the remaining 8 performances will occur on orbits N+1, N+2, N+4, N+6, N+10, N+14, N+22, and N+30. (Note: Some unattended operation will be required to accomplish this performance schedule, however, unattended operation is to be minimized).

Successive pointings will follow the original element, if possible, otherwise point at a good nearby element within 30 arc seconds of the first. Once initiated, the entire series will be run to completion, even if the original network element decays.

JOP 1E) Short term evolution in the network

Point at the network boundary, maximize detector No. 1 or 3 and perform BB-11 five times with no change in pointing.

JOP 1F) Spicules at the limb

The PI's or the crewman will select an area on the limb where spicules are distinct.

a) The ATM will be pointed so that the S055A aperture is 5 arc seconds above the photospheric limb and the S082B slit is radially oriented, with the bottom of the slit 2 arc seconds above the limb. Maintain this pointing and roll orientation and perform the following:

- 1) BB-7 or BB-10 once.
- 2) BB-18 or BB-19 once.
- 3) BB-7 or BB-10 once.

b) With the same initial pointing and roll orientation as in (a), perform the following:

- 1) BB-27 once.
- 2) Repoint the S082B slit 2 arc seconds to the right and repeat BB-27.
- 3) Repeat (2) five additional times.
- 4) Point the S082B slit at 5, 7 and 10 arc seconds above the limb and perform BB-27 for background.

Unattended/Unmanned Scheduling Guidelines

JOP 1AU) Network regions will be selected by the Principal Investigators.
 JOP 1BU) Selection will be based on, but will not be limited to, the degree of definition and brightness of the network in $H\alpha$ or Ca II K, and the distance from nearby centers of activity and the limb.

Commensurate with STDN station coverage, the following set of unattended/unmanned building blocks will be performed:

- a) At the station acquisition, the ATM will be pointed to sun center and BB-U3 performed. (It may require more than one station pass to perform and verify that the desired grating position has been reached.)
- b) At the first command opportunity after completing (a) above, point to the selected network and perform BB-U1. S052 will not operate.
- c) At the next ground station, perform BB-U3. S052 will not operate.
- d) At the next commanding opportunity after the end of BB-U3 in (c) above, perform BB-U1. S052 will not operate.

The number of repetitions of this sequence desired will be determined during the detail planning period and will be a function of solar activity, unattended orbits available, and the STDN station coverage.

JOP 1DU) The unattended/unmanned portion of JOP 1D will be performed as follows:

With the ATM pointing at the bright network region previously selected in JOP 1D, perform BB-U1 during those unattended/unmanned orbits required to satisfy the orbital sequence specified in JOP 1D. S052 will not operate.

Evaluation

JOP 1A) Information on the three dimensional structure of the network thru
 JOP 1F) will be obtained by X-ray filtergrams from the S054 and S056 instruments, and spectroheliograms from the S055A and S082A instruments. Detailed information on spicules will be obtained.
 JOP 1AU)
 JOP 1BU) Detailed information on the variation of temperature and density, as a function of height, will be obtained through a combination of filtergrams and spectroheliograms, as well as through the use of XUV spectra taken by S055A and S082A.
 JOP 1DU)

Velocities will be obtained from spectral line shapes by S082B.

The data will be used in construction of the evolutionary development of the network.

Data Requirements

See Appendix A.

Purpose and Background

Performance of the operations specified in this JOP will provide data to support:

- a) The investigation of the three dimensional structure of active regions.
- b) A study of the horizontal and vertical variation of the temperature, density, velocity, and magnetic field.
- c) A study of the short term (minutes to hours) and long term (days) evolution of the chromosphere, transition region, and corona in active regions.
- d) A determination of the relationship between the three dimensional structure of an active region and its evolution as it relates to the production of flares and other transient phenomena.
- e) The investigation of the structure of the photosphere, chromosphere, transition region, and corona in and above sunspots.
- f) The mapping of differential velocity fields in the chromospheric transition, and coronal layers over active regions and other solar features.

Scientific Objectives

- JOP 2A) Observe a rapidly developing active region.
- JOP 2B) Observe the long term evolution of an active region as it crosses the disk.
- JOP 2C) Observe the long term evolution of an active region as it crosses the limb.
- JOP 2D) Observe active regions which have "interesting" structure.
- JOP 2E) Observe large sunspots.
- JOP 2F) Observe an active region to determine chromospheric velocities.
- JOP 2G) Observe an Ellerman bomb anywhere on solar disk.

Manned Scheduling Guidelines

- JOP 2A) thru JOP 2F) Coalignment is assumed between S055A, S082B, and H α for each performance of this JOP.

JOP 2A) Rapidly Developing Active Region

A rapidly developing active region will be selected for study by the crew and/or Principal Investigators (PI's). Performance of the building blocks will depend upon the rate of development of the region and/or the flaring rate of the region.

It is desirable that the S082B slit be filled by uniform emission in the active region.

ATM JOP-2

- a) Building Block 4 (BB-4) or BB-5 will be performed as soon as the subject region has been selected.
- b) After the initial performance of BB-4 or BB-5 in (a) above, performances of BB-4, BB-5, BB-6, BB-7 or BB-10, or combinations thereof will be required. The number, and kinds, of performances will be determined during detail mission planning.
- c) If the selected region is outside $0.7 R_g$, BB-2 shall be performed. The number of performances required will be determined during detail mission planning.
- d) Roll the S082A dispersion clear for BB-4A and BB-6B; for BB-2 roll the S052 pylon away from the feature of interest and clear the S082A dispersion, if possible; otherwise the roll orientation is controlled by S082B. Also, roll the S082A dispersion clear in BB-5A, BB-7 and BB-10, if possible.
- e) Either at the daily planning session, or during the execute period, the PI's may decide that the flare probability of an active region is sufficiently high to warrant observations of that region as follows:
 - 1) Align the S082B slit along the neutral line and perform BB-24.
 - 2) If a flare occurs, truncate BB-24 and initiate JOP-3A. If BB-24 is scheduled during the execute period, the ATM crewman will be requested to substitute BB-24 for the previously scheduled ATM operations for a fixed period of time. For this case, the voice uplink version of BB-24 (with all operating modes defined) is to be used.

It is highly desirable that the Video Tape Recorder (VTR) be utilized during the operation of BB-24 and subsequent JOP-3 operations as follows:

- 1) The VTR is to be dumped of all data to allow the entire 30-minute record capability of the tape to be used to record flare wait, flare rise and (if possible) flare fall data.
- 2) XUV MON (normal) data will be recorded on the VTR during the operation of BB-24. The VTR will be turned on at the beginning of the orbit and, if no flare has occurred, turned off at the end of the orbit.
- 3) If a flare occurs, the VTR will be allowed to operate for a total of 15 minutes from the time the flare alarm sounds or until the end of the orbit (whichever comes first).

Availability of the VTR to collect XUV MON data will not constrain the scheduling of BB-24.

JOP 2B) Evolution

JOP 2C) The active region selected will be capable of study for a minimum of 10 days and at least one limb passage. It is desirable that the observation be from limb to limb including 2 days beyond each limb passage. Additionally, it is desired that one of the selected active regions be observed for two solar rotations, if possible.

Roll the S082A dispersion clear for BB-4A and BB-6B; roll the S052 pylon away from the feature of interest and clear the S082A dispersion, if possible, for BB-2; otherwise the roll orientation is controlled by S082B. Also, roll the S082A dispersion clear in BB-5A and BB-7, if possible.

JOP 2B) Long Term Evolution - Disk

When the active region is on the disk, perform BB-4 once every two days for a minimum of ten days. On the days when BB-4 is not performed, BB-5 or BB-7 will be performed. For each performance, the ATM will be pointed at several different areas of the active region plage.

For the S055A spectra, the pointing may be adjusted so that the output of detector No. 1 or 3 is maximized. If this option is to be followed it will be specified on the PAD.

If the selected region is outside $0.7 R_{\odot}$, BB-2 shall be performed. The number of performances required will be determined during detail mission planning.

JOP 2C) Long Term Evolution - Limb

When the active region is within one to two days on either side of limb passage, perform all or part of the following sequence:

- a) One performance of BB-2.
- b) One performance of BB-5.
- c) Three performances of BB-6.
- d) One performance of BB-13 or BB-23. (Requires three consecutive orbits.)
- e) One performance of BB-14.
- f) One performance of BB-2.

The number of performances of BB-2 will be determined in detail mission planning.

JOP 2D) Structure

The ATM will be pointed at positions within the active region, and a series of performances of BB-4, BB-5, BB-6, and/or BB-7 will be made, as determined during detail mission planning.

Roll the S082A dispersion clear for BB-4A and BB-6B; otherwise the roll orientation is controlled by S082B. Also, roll the S082A dispersion clear in BB-5A and BB-7, if possible.

JOP 2E) Sunspots

An active region containing large sunspots will be selected for observation.

If at all possible, choose a sunspot whose umbra has a diameter of 60 arc seconds or greater;

- a) The ATM will be pointed at two positions in the center of the umbra and BB-6 will be performed once at each position.
- b) After completing (a) above, the ATM will be pointed at two positions in the penumbra and BB-6 will be performed once at each position.

Roll for optimum S082B slit orientation in BB-6A, and to clear the S082A dispersion in BB-6B.

JOP 2F) Chromospheric Velocities

The ATM will be pointed at an active region chosen by the PI's.

Roll to 0 or 10800 arc minutes orientation for S055A in BB-7 and BB-19 and for optimum S082B slit orientation in BB-10.

- a) Perform BB-7 or BB-10 once.
- b) When the S055A line scan is east-west, BB-19 will be performed once, such that the line scan will cross both active and quiet regions.
- c) Upon completion of (b), perform BB-7 or BB-10 once.
- d) Steps (a) through (c) will be repeated, as required by the PI's.

JOP 2G) Point the ATM at a PI selected active region that is likely to produce an Ellerman bomb during the observation period. The crewman is to attempt to locate an Ellerman bomb using primarily the H-Alpha displays. If an Ellerman bomb is sighted, point the ATM at the bomb (using the H-Alpha reticles) and perform BB-10. If data are taken on an Ellerman bomb, perform an additional BB-10 at the same pointing for background.

Unattended/Unmanned Scheduling Guidelines

JOP 2AU) A rapidly developing active region will be selected for study by the Principal Investigators. Performance of the unattended/unmanned building blocks will depend upon the rate of development of the region and/or the flaring rate of the region, and the STDN station coverage.

At ground station acquisition, point the ATM at the active region and perform BB-U1, BB-U2, BB-U3, or BB-U4. S052 will not operate.

The numbers and kinds of performances desired will be determined during the detail planning period each day.

ATM JOP-2

For those regions outside $0.7 R_0$, perform the following:

At ground station acquisition, point the ATM at sun center and perform BB-U1.

The number of repetitions of this BB-U1 operation will be determined during the detail planning period each day.

JOP 2BU) An active region suitable for long term evolution study will
JOP 2CU) be selected by the Principal Investigators.

At selected times during the unattended/unmanned periods, the ATM will be pointed at the active region and BB-U1, BB-U2, or BB-U3 will be performed. S052 will not operate.

When the active region is near limb passage, in addition to the above, the ATM will be sun centered and BB-U1 will be performed.

The number of repetitions of this operation will be specified during the detail planning period each day.

JOP 2DU) An active region will be selected by the Principal Investigators and the following sequence will be performed:

At the ground station acquisition, point the ATM at the active region and perform BB-U1, BB-U2, or BB-U3. S052 will not operate.

The number and kinds of performances desired will be determined during the detail planning period each day.

Evaluation

JOP 2A) Information about the three dimensional structure of active
thru regions will be gleaned from S054 and S056 X-ray filtergrams
JOP 2F) and spectroheliograms from S055A and S082B. Information on
JOP 2G) rapid changes in the coronal structure (S054 and S056) and
JOP 2AU) coronal and chromospheric structure (S055, S082A and S082B)
thru of an active region with a high flare probability will be
JOP 2DU) provided. The data may also provide information on conditions in the active region which give rise to a flare and which occur during the onset of a flare.

The spectra obtained by S055A and S082B will provide information concerning the variation of temperature, density, and velocity as a function of height. White-light pictures of the corona from S052 will provide detailed descriptions of the density structure of the corona overlying active regions.

Observations obtained at a rate compatible with the time scale of development of the regions will be used for evolutionary studies.

Data Requirements

Refer to Appendix A.

Purpose and Background

The objective is to observe a number of solar flares with as many of the ATM experiments operating simultaneously as is feasible. The objective is to obtain a diverse and extensive collection of data which can be used to determine the point where the flare started, physical conditions (temperature, density, magnetic field, and particle velocities) in the flare plasma and the surrounding medium, and to determine how these conditions change before, during, and after the flare.

Although the study of flares is a separate program it is linked to the study of active regions in other programs, particularly ATM JOP-2 and ATM JOP-6.

Scientific Objectives

JOP 3A) Investigate flares on solar disk.

JOP 3B) Investigate limb flares.

Manned Scheduling Guidelines

JOP 3A) Each day, the Principal Investigators (PI) will establish two
JOP 3B) limiting values for the PMEC readout, low (L) and high (H), to be used to set the flare threshold for the next day. The flare detector will be set for the low threshold setting and (except for S056) the flare programs will not be initiated until this value is exceeded. Preparations for taking data, however, may be accomplished prior to this time.

Each day, the crewman will check the omit list to determine which experiments will not be operated during any flares that may occur that day.

On days of high flare probability the S082A doors will be opened at the beginning of each ATM orbit.

When the low threshold setting is reached, the crewman will initiate the flare programs of BB-8 or BB-9 as follows:

- a) Verify that the OWS is not in the SAA and then initiate flare rise observations for S054 and S056. Refer to PAD for proper mode for S054 (i.e., A, B, or C). Initiate the three second TIME mode for S082A. Short wavelength is preferred; however, long wavelength is acceptable.
- b) Start S055A in MLS mode if the instrument is already set up for one of the three mirror modes; otherwise initiate the grating selection by going to mode REF.
- c) A slew day is assumed unless delayed slew day is indicated on the PAD.

If the day is a delayed slew day, data will be taken without slewing to the flare for the duration of flare rise. The S082A experiment is not to be placed in the flare mode if the flare can not be seen. At flare peak slew to the flare and initiate the flare fall programs of BB-8 or BB-9.

If the day is a slew day, locate the flare as quickly as possible, slew to it and initiate S082A and S082B in the flare mode. If the crewman cannot see the flare on the monitor, slew to sun center and attempt to locate the flare. If necessary, look for confirming indications of X-ray activity on other ATM indicators. If the flare cannot be seen, or if the flare alarm is determined to be a false indication, terminate operations.

- d) If grating selection was initiated in step (b), stop the selection at the first of the following opportunities and initiate S055A in the MLS mode.
 - 1) GRAT 0000, DET ALL
 - 2) GRAT 0757, DET 1-5
 - 3) GRAT 1288, DET 1-5
 - 4) GRAT 1928, DET 1-5
 - 5) GRAT 2686, DET 1-5
 - 6) GRAT 3450, DET 1-5
- e) If BB-8 has been specified for limb flare observations, then BB-8 will be performed no matter where the flare occurs. If it has not, then the crewman must determine if the flare is a disk flare (within $0.7 R_{\odot}$) or a limb flare (outside $0.7 R_{\odot}$) by examination of $H\alpha$, X-ray or XUV monitor and select either BB-8 or BB-9, respectively.
 If BB-8 selection is made, proceed to JOP 3A, otherwise proceed to JOP 3B.
- f) The crewman is to exercise his own judgement in the early initiation of the S056 flare program. It is not necessary that the flare threshold be exceeded prior to initiation. If, at a later time, the X-ray flux peak does not exceed the flare threshold limit, the crewman may terminate the S056 flare program.

JOP 3A) Disk Flare or Limb Flare: BB-8

- a) If the flare intensity has reached the high threshold setting, the high intensity (H) flare programs of BB-8 for experiments S056, S082A and S082B will be followed. The operation of the other experiments is unaffected by flare intensity.
- b) If the H threshold has not been reached, the low intensity (L) flare programs of BB-8 for experiments S056, S082A and S082B will be followed. The operation of the other experiments is unaffected by flare intensity.
- c) The flare fall program shall be operated until the flare flux intensity has reached a slow rate of decay, at which point the post flare program will be initiated.

ATM JOP-3

- d) Continue the post flare program BB-8 for a full second orbit following the one in which the flare occurs. If S082A and S082B run automatic flare programs in BB-8 (H-Case), BB-10 will be run once at the beginning of each orbit for up to five orbits following the performance of BB-8. Terminate when brightening on XUV MON disappears.

JOP 3B) Limb Flare: BB-9

- a) At 5 minutes after flare alarm, stop S082A and S082B, slew to sun center and continue with the flare fall programs of BB-9.
- b) If the high flare threshold has been reached, the high intensity (H) flare programs of BB-9 for experiments S056 and S082A will be followed. The operation of the other experiments is unaffected by flare intensity.
- c) If the high flare threshold has not been reached, the low intensity (L) flare programs of BB-9 for experiments S056 and S082A will be followed. The operation of the other experiments is unaffected by flare intensity.
- d) The crewman will check the WLC MON at the times provided in BB-9 and if motion of a white light feature is observed, initiate the FAST SCAN mode; otherwise, initiate the EXT D STD mode.
- e) The flare fall program shall be operated until the flare flux intensity has reached a slow rate of decay, at which point the post flare program will be initiated.
- f) Continue post flare for a full second orbit unless S082A high (H) option was followed in BB-9. In this case BB-2 and BB-10 will be performed once at the beginning of each orbit, for five consecutive orbits, following the performance of BB-9.

Manned Scheduling Guidelines (Crewman awake but not at ATM C&D panel)

- JOP 3A) If the ATM panel is unattended and the crewman is awake when
- JOP 3B) the flare occurs (i.e., flare alarm system is active and alarm tone sounds) the following sequence of operations shall be followed:
 - a) Reset the flare threshold to the high (H) threshold setting
 - b) Verify that the Orbital Assembly is not in the SAA
 - c) Perform flare preparations sufficient to verify that the PMEC count is greater than the threshold setting and to enable all experiments for eminent operation in BB-8 or BB-9.

ATM JOP-3

- d) Locate flare and slew to it as quickly as possible. Initiate the flare fall programs of BB-8 or BB-9 beginning with the grating select for S055A and with the second sequence for S054. If the crewman cannot see the flare on the monitor, slew to sun center and attempt to locate the flare. If necessary, look for confirming indications of X-ray activity on other ATM indicators. If the flare cannot be seen, or if the flare alarm is determined to be a false indication, terminate operations.
- e) If BB-8 has been specified for limb flare observations, then BB-8 will be performed no matter where the flare occurs. If it has not, then the crewman must determine if the flare is a disk flare (within $0.7 R_{\odot}$) or a limb flare (outside $0.7 R_{\odot}$) by examination of H_{α} , X-ray or XUV monitor and select either BB-8 or BB-9, respectively.
- If BB-8 selection is made, proceed to JOP 3A c); otherwise proceed to JOP 3B e).

Unattended/Unmanned Scheduling Guidelines

- JOP 3AU) If the ATM panel is unattended and the crewman is not awake
JOP 3BU) when the flare occurs (i.e., flare alarm system inactive) the ATM PI's will make the determination of the occurrence of a flare for the performance of JOP 3BU or JOP 3CU.
- JOP 3AU) At the first ground station acquisition, after a flare occurs, the ATM will be flare-centered and BB-U1, BB-U5, BB-U6, BB-U7, BB-U8, BB-U9, or BB-U10 will be performed except that S052 will not be operated. The BB's will be repeated at each possible ground station until the PI's request that they be terminated.
- JOP 3BU) Same as JOP 3AU except ATM will be sun centered and S052 will be operated.

Evaluation

- JOP 3A) Information about the development in time and space of the
JOP 3B) high temperature ($T \gtrsim 10^6$ °K) plasma associated with the flare
JOP 3AU) will be obtained by S054 and S056. The development in time
JOP 3BU) and space of plasma with intermediate temperatures ($10^4 \lesssim T \lesssim 4 \times 10^6$ °K) will be studied by S055A and S082A, while S082B studies the time history of the bright part of the flare over the temperature range 4000°K to 10^5 °K. In addition to studying the flare itself, S054, S055A, S056, and S082A may also observe associated phenomena such as surges, flare spray, etc. For limb flares, S052 will study coronal phenomena associated with the flare, while S054, S056, and S082A will study the development in time and space of the flare itself and any associated phenomena.

ATM JOP-3

Data Requirements

Refer to Appendix A.

Purpose and Background

Performance of the operations specified in this JOP will provide data to support:

- a) A study of the short and long term evolution of prominences and filaments as they cross the disk, and the evolution of the chromospheric, transition, and coronal layers in the vicinity of these features.
- b) Investigations of the three dimensional structure of prominences and filaments, and of the surrounding corona. A determination of the temperature and density in the cool filamentary structure making up a prominence or filament, and of the interface between the cool material (chromospheric temperatures) and the hot coronal material in which the filamentary structure is imbedded.

Scientific Objectives

- JOP 4A) Observe and record the evolution of a prominence/filament as it develops and traverses the disk, and make observations on the second solar rotation.
- JOP 4B) Investigate the structure of a selected prominence.
- JOP 4C) Investigate the structure of a selected filament.

Manned Scheduling Guidelines

- JOP 4A) Roll the S082A dispersion clear for BB-6B; roll to + 5400 arc thru minutes orientation for S052 in Building Block 2 (BB-2) or sun centered BB-28 and clear S082A dispersion, if possible; JOP 4C) otherwise the roll orientation is controlled by S082B. Also, roll the S082A dispersion clear for BB-3, if possible.

Coalignment between S082B, S055A, and $H\alpha$ is assumed during the performance of this JOP.

JOP 4A) Evolution of Prominences and Filaments

The ATM will be pointed at a bright linear element in a selected prominence on the east limb.

- a) The following building blocks will be performed while the instrument is pointed at selected points in the prominence, except that the instrument will be pointed at sun center for BB-2 and for the sun centered BB-28:
 - 1) BB-2 or sun centered BB-28 will be performed once.
 - 2) BB-3 will be performed twice.
 - 3) BB-6 will be performed at least three times.
 - 4) BB-11 will be performed once.
 - 5) BB-14 will be performed twice.
 - 6) Two BB-28's may be used in place of one BB-3 or one BB-14.

- b) As the prominence leaves the east limb and becomes a filament, perform the following sequences as the filament crosses the disk.
 - 1) When the target is outside $0.7 R_{\odot}$:
 - Perform BB-3 once.
 - Perform BB-2 or sun centered BB-28 once.
 - Perform BB-6 three times.
 - 2) When the target is within $0.7 R_{\odot}$:
 - Perform BB-3 once.
 - Perform BB-6 three times.
- c) Repeat (a) when filament becomes a prominence on west limb. If a suitable prominence is not available on the east limb, the above may be initiated with a filament.
- d) When the filament returns as a prominence on the east limb, the ATM will be pointed at selected positions and a series of performances of BB-2 (sun centered), BB-3, BB-6, BB-11, BB-14 and/or BB-28 will be made as determined during the detail mission planning period. Roll the ATM to clear the S082A dispersion.

JOP 4B) Study of Interesting Prominence Structure

A prominence on either the east or west limb which exhibits interesting structures will be selected for viewing, and the following operations will be accomplished.

- a) BB-2 or sun centered BB-28 will be performed once.
- b) The ATM will be pointed at a bright linear element in the prominence and BB-3 will be performed two times, consecutively.
- c) The ATM will be pointed at a minimum of three additional places within the prominence, and BB-6 will be performed at each pointing. It is desirable that BB-11 also be performed at each pointing.
- d) BB-14 will be performed twice, while the ATM is pointed just outside the prominence with the S082B slit parallel to limb.
- e) Two BB-28's will occasionally be substituted for one BB-3 or one BB-14.

JOP 4C) Study of an Interesting Filament

A filament will be selected for viewing and the following operations will be accomplished.

- a) The ATM will be pointed at an interesting feature of the filament and BB-3 will be performed.

- b) The ATM will be pointed at three additional positions in the filament and BB-6 will be performed at each position.
- c) If the filament is near the limb, BB-2 or a sun centered BB-28 will be performed.

Unattended/Unmanned Scheduling Guidelines

- JOP 4AU) A prominence on either the east or west limb will be selected by the Principal Investigators and the following sequence will be performed:
- a) The ATM will be pointed at a specified bright linear element in the prominence and either BB-U1, BB-U2, or BB-U3 will be performed. At successive command opportunities, this will be repeated for several selected points within the prominence. S052 will not operate.
 - b) In addition to the above sequence, point the ATM at sun center and perform BB-U1.

The number and kinds of performances desired will be determined during the detail planning period each day.

- JOP 4BU) The ATM will be pointed at a bright linear element in the prominence selected by the Principal Investigators and either BB-U1, BB-U2, or BB-U3 will be performed.
- a) The ATM will be pointed at a bright linear element in the prominence and either BB-U1, BB-U2, or BB-U3 will be performed. At successive command opportunities, this will be repeated for several selected points within the prominence. S052 will not operate.
 - b) In addition to the above sequence, point the ATM at sun center and perform BB-U1.

The number and kinds of performances desired will be determined during the detail planning period each day.

- JOP 4CU) A filament will be selected for viewing over a period of time.
- a) The ATM will be pointed at a selected feature of the filament and BB-U1, BB-U2, or BB-U3 will be performed. At successive command opportunities, this sequence will be repeated for several other features within the filament.
 - b) In addition the above sequence, point the ATM at sun center and perform BB-U1.

The number and kinds of performances desired will be determined during the detail planning period each day.

Evaluation

JOP 4A) The S054 and S056 X-ray filtergrams, together with the S055A
thru and S082A spectroheliograms, will provide three dimensional
JOP 4C) information on temperatures and densities. Spectra obtained
JOP 4AU) from S055A and S082B, when used with the filtergrams and
thru spectroheliograms, will provide very detailed temperature and
JOP 4CU) density information at selected positions. The S052 white-
light pictures of the corona will provide a detailed description
of the density structure of the corona above prominences.

Observations carried out at a rate compatible with the time
scale of changes in the structure will be used for evolutionary
studies.

Data Requirements

Refer to Appendix A.

Purpose and Background

Performance of the operations specified in this JOP will provide data to support:

- a) Improvement of models describing the nature of the atmosphere of the quiet sun.
- b) The determination of the variation in physical properties (temperature and density) at various solar latitudes and heights.
- c) Determination of the velocity of material at different levels.

Scientific Objectives

- JOP 5A) Measure the variation of the XUV spectrum along several constant latitude lines and across the limb.
- JOP 5B) Measure the variation of the XUV spectrum as a function of latitude along the north or south polar axis, and across the limb.
- JOP 5C) Investigate various solar conditions at the limb.

Manned Scheduling Guidelines

JOP 5A) Variation of the XUV Spectrum Along Constant Latitude Lines

Several target areas will be selected for constant latitude scans. For example:

Quiet areas of the sun.

A region at the limb where XUV emissions in the chromosphere are slightly above normal.

A region at the limb where intensity of chromospheric emissions are less than normal (depressed region or coronal hole).

Nominally, each performance will consist of a constant latitude scan from the central meridian to the limb, and then across the limb.

Each constant latitude scan will point at sun center and the following approximate positions of -130° , -45° and -20° arc seconds inside the limb, at the limb, and positions -10 , -5 , 0 , $+5$, $+10$, and $+20$ arc seconds from the limb.

Specific positions including roll angle will be uplinked to the ATM operator from the ground. While the distances from the limb are only approximate, the S082B slit must be carefully aligned so as to be parallel to the limb. The distance from the limb is to be measured along a radius.

*NOTE: It is important that the points be at uniform quiet regions; therefore, greater value is placed on that characteristic than on being at the prescribed location.

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A constant latitude scan will be conducted in the following manner:

- a) Point the ATM at sun center and perform Building Block 2 (BB-2).
- b) Point the ATM to the Central Meridian at the chosen latitude and perform BB-6 once on the constant latitude line.
- c) Point the ATM to 130, 45, and 20 arc seconds inside the limb and perform BB-6.
- d) Point the ATM at the limb and perform BB-13 or BB-23 once. (Requires 3 consecutive orbits).
- e) Additionally, the following sequence must be performed on two orbits.
 - 1) Point the ATM at the limb. Perform BB-29 with the S055A mirror pointed at -10 arc seconds for the first grating 3 scan, -5 arc seconds for the second grating 3 scan and 0 arc seconds for the third grating 3 scan.
 - 2) Point the ATM at the limb. Perform BB-29 with the S055A mirror pointed at +5 arc seconds for the first grating 3 scan, +10 arc seconds for the second grating 3 scan and +20 arc seconds for the third grating 3 scan.

JOP 5B) Variation of the XUV Spectrum at the North and South Poles

- a) Polar limb studies will be conducted along the central meridian by carrying out (c), (d), and (e) above. Roll the S082A dispersion clear for BB-6B except for the three orbit sequence controlled by S055A and described in JOP 5A (e); roll to +5400 arc minutes orientation for S052, then roll to clear the S082A dispersion in BB-2; otherwise, the roll is controlled by S082B.
- b) Additionally, XUV mapping of the north pole shall be accomplished by performing BB-13 or BB-23 four times, spaced evenly throughout the solar rotation (approximately 8 day intervals).

JOP 5C) Limb Scans

Limb studies will be conducted on crew selected features on the limb by pointing the ATM at those features and performing BB-13 or BB-23 at each limb position. The ATM crewman will be given wide latitude in the selection of the features to be studied. Candidate features are:

- 1) Active regions
- 2) Quiet regions
- 3) Depressed coronal and chromospheric regions
- 4) Gaps in XUV images at the limb
- 5) XUV bright spot at the limb
- 6) Equator
- 7) 45 degrees north and 45 degrees south
- 8) Sector boundary at the west limb

ATM JOP-5

Unattended/Unmanned Scheduling Guidelines

JOP 5AU) At each of 3 consecutive ground stations, point the ATM at several constant latitude lines. At each point perform BB-U1, BB-U2, or BB-U3. S052 will not operate unless the ATM is sun centered.

The numbers and kinds of performances desired will be determined during the detail planning period each day.

Evaluation

JOP 5A) Synoptic pictures will be obtained by the operation of S052,
JOP 5B) S054, S056, and S082A. Spectral observations by S055A and
JOP 5C) S082B, and spectroheliograms by S082A will be taken at a
JOP 5AU) number of points along several constant latitude lines extending from the central meridian across the limb into the corona and along the central meridian across one or both poles. Information on the three dimensional structure of the solar atmosphere will be obtained from X-ray filtergrams from S054 and S056, and spectroheliograms from S055A and S082A. Detailed information on the variation of temperature and density with height in selected regions will be obtained through a combination of filtergrams and spectroheliograms plus XUV spectra taken by S055A and S082B. Velocities will be obtained from spectral lines.

Data Requirements

Refer to Appendix A.

Purpose and Background

Performance of the operations specified in this JOP will provide data to support the investigation of the evolution of the quiet and active features of the sun, in a variety of wavelengths. A primary purpose is to aid in the construction of 3-dimensional pictures of the inner and outer corona.

Scientific Objectives

Obtain coronagraph pictures, X-ray images, and XUV images and spectra of the quiet and active sun at regular intervals. Information on the evolution of the coronal layers of quiet and active regions will be obtained by S052, S054, S056, and S082A.

Manned Scheduling GuidelinesJOP 6) Synoptic Observations

- a) Building Block 1 (BB-1) shall be performed two times per day at intervals of 10 to 14 hours. For each performance, roll to 00000 or 10800 arc minutes and perform Part A of BB-1. Then roll to ± 5400 arc minutes and perform Part B of BB-1.
- b) Daily, two successive BB-2's may be planned for a manned ATM orbit, within one orbit of the mid-orbit between the two BB-1's scheduled for that day. Occasionally a sun centered BB-28 will be substituted for one of these two BB-2 performances. The instrument will be sun centered and a 90 degree roll maneuver will be performed between the two BB-2's. Initial roll position will be optimized for S082A. Once, toward the end of the mission (i.e., S052 less than 400 frames remaining) a special long exposure (5 minutes or less) will be substituted for the usual STD mode for S052 in BB-2.
- c) With the ATM pointed at sun center and roll orientation either for S052 at ± 5400 arc minutes or for S082A dispersion clearance, it is desirable to perform BB-2 once every two hours over the duration of the entire mission. It is planned that roll will be controlled by S082A for dispersion clearance on approximately one of every four performances of this BB.

Unattended/Unmanned Scheduling Guidelines

JOP 6U) Select one of the building blocks BB-U1 through BB-U14 for performance as near as possible to once every two hours during all unattended/unmanned operating periods.

Evaluation

JOP 6) Information on the evolution of the chromospheric and transition layers will be obtained by S082A. S055A and S082B will obtain data applicable to studying the chromospheric, transition, and

coronal layers of selected areas near the center of the disk.
Three dimensional pictures of the inner and outer corona will
be constructed utilizing the accumulated data.

Data Requirements

Refer to Appendix A.

Purpose and Background

Performance of the operations specified in the JOP will provide data to support:

- a) Studies of the variation in height of the major, and possibly some minor, constituents of the earth's atmosphere.
- b) Studies to establish the absorption cross-sections of the major and minor constituents at various wavelengths.
- c) Investigations of the variability of concentration profiles of the earth's atmosphere with respect to seasons, latitude during magnetic storms, and different levels of solar activity.
- d) Investigations of atmospheric scattering at visible wavelengths and attenuation and scattering in UV.

Scientific Objectives

JOP 7) Perform coordinated observations of atmospheric extinction.

Manned Scheduling GuidelinesJOP 7) Atmospheric Extinction

Building Block 15 (BB-15) will be performed at least once per day.

The decision to perform the coordinated observations will be dependent upon solar conditions, film supply, orbit, and analysis of S055A data.

Most of the time operations of BB-15 will consist of only the operation of S055A.

A specific start and stop time for experiments S054, S056 and S082B will be provided on the PAD. This time will be based on the following vehicle-sun grazing heights for these experiments.

<u>Experiment</u>	<u>Minimum</u>	<u>Maximum</u>
S054	40 km	250 km
S056	40 km	250 km
S082B long wavelength	40 km	300 km
S082B short wavelength	80 km	400 km

Evaluation

JOP 7) Data from S052, S054, S055A, S056, and S082B will provide information on the height variation of major constituents. The data will also provide information on the absorption cross-sections of these constituents at various wavelengths. Observations made at different times will provide information on the variability of the concentration profiles with season, latitude, during times of geomagnetic storms and different levels of solar activity. Information on the total solar ionizing flux will be

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obtained with ATM JOP-6 observations through the integration of XUV scans telemetered to the ground and of densitometry of the S052, S054, S056 and S082B photographs. S052 and S082B (long wavelength) will contribute to the height profile of aerosols and other scattering material.

Data Requirements

Refer to Appendix A.

Purpose and Background

Performance of the operations specified in this JOP will provide data to support:

- a) Investigations into the origin of chromospheric and coronal transient phenomena, the temporal and spatial evolutions, and the correlation with surface and inner coronal features.
- b) Determination of the correlation of transient events observed at radio wavelengths with white-light, EUV, and X-ray manifestations.
- c) Determination of the velocity of propagation of transient phenomena through the corona, and the influence of existing coronal and chromospheric structures on flow properties.
- d) Mapping the spatial structure of transients observed in white-light, XUV, and X-rays.

Scientific Objectives

Observe and record data generated by a Type II, Type III, and Type IV radio burst, surge, eruptive prominence, disappearing filament, or other coronal transient.

- JOP 8A) Investigate transient events outside $0.7 R_{\odot}$.
- JOP 8B) Investigate WLC transient events.
- JOP 8C) Investigate transient events with no correlative disk event.
- JOP 8D) Investigate solar phenomena preceeding a coronal transient event.

Manned Scheduling Guidelines

- JOP 8A) H α or XUV transient events
thru
JOP 8C)

The event to be observed is outside $0.7 R_{\odot}$ of sun center.

For sun centered observations, roll to position the S052 pylon opposite to the transient event and, if possible, to clear the S082A dispersion.

- JOP 8A) Transient events outside $0.7 R_{\odot}$

Following a surge, eruptive prominence, or disappearing filament, the astronaut will perform either (a) or (b) below, as indicated on the PAD.

- a) With the ATM pointed at the manifestation (H α , XUV, or X-ray), or the last location of manifestations of the event:
 - 1) Roll to obtain uniform emission along the S082B slit and, if possible, clear S082A dispersion of the transient event, and perform Building Block 10 (BB-10) up to a maximum of four times or until the end of the daylight portion of the orbit. (Perform even though manifestations, visible using onboard displays, may have disappeared.)

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- 2) Upon completion of (1) above, and on the next orbit, point the ATM at the sun's center and perform BB-17 for the whole pass.
- b) With the ATM pointed at the sun's center:
 - 1) Perform BB-16 once.
 - 2) Upon completion of (a) above, perform BB-17 for the remainder of the pass, and for the whole of the next pass.

JOP 8B) WLC transient event

Once a WLC transient event has been observed, the crewman will attempt to detect motion of the observed material.

- a) If motion is detected, initiate BB-16. During the WLC MON part of BB-16 the crewman will determine if there has been a significant change in shape or position (1.5 R_g in 15 minutes).
 - 1) If a significant change is detected, reinitiate BB-16 and repeat step a).
 - 2) If a significant change is not detected, initiate BB-17 and repeat for the remainder of the orbit and all of the following orbit.
- b) If motion is not detected, initiate BB-17 for the remainder of the orbit and all of the following orbit.

JOP 8C) Ground detected transient event

Following a coronal transient event detected by the ground and not detected by the crewman follow the steps suggested by the ground.

JOP 8D) Coronal transient wait

When the Principal Investigators determine that the probability of a coronal transient is high, BB-25 may be repeated for one or more orbits. BB-25 will be scheduled via a voice update during the execute period by requesting that the ATM crewman delete scheduled ATM operations and substitute BB-25. BB-25 will be performed for a fixed period of time or until a transient event occurs. If a transient event occurs, terminate BB-25 and initiate JOP 8A or JOP 8B, as appropriate.

Unattended/Unmanned Scheduling Guidelines

- JOP 8AU) Following a Type III burst, surge, eruptive prominence or disappearing filament, the Principal Investigators may decide to select one of the two options listed below.
- a) At the first ground station acquisition after the event occurs point the ATM at sun center and perform BB-U1 or BB-U5. At the next station acquisition perform BB-U1. Continue performing BB-U1 until the PI's request that it be terminated.

ATM JOP-8

- b) Same as (a) except ATM is to be event centered and BB-U1 or BB-U4 will be performed. S052 will not operate.

JOP 8CU) Following a Type II, Type III or Type IV radio burst:

At the first ground station acquisition after the event occurs, point the ATM to sun center and perform BB-U1. Repeat the BB-U1 operation at each ground station thereafter until the PI's request a termination.

Evaluation

- JOP 8A) thru JOP 8CU) The ATM data will contain information on the origin of chromospheric transient phenomena (from S055A, S082A, and S082B) and coronal transient phenomena (from S052, S054, S055A, S056, and S082A), their temporal and spatial evolution, and their correlation with surface and inner coronal features. The data will also provide information on the velocity of propagation of transient phenomena through the corona and the influence of existing chromospheric and coronal structures on flow properties.
- JOP 8D) The data from S052, S054 and S056 will provide information on changes and features which can be associated with the evolution of a coronal feature. The data may also provide information on the coronal conditions of an active region at the onset of a flare.

Data Requirements

Refer to Appendix A.

Purpose and Background

Performance of the operations specified in the JOP will provide data to support:

- a) Investigations of the rate of expansion of various parts of the solar corona and the effects of the coronal expansion (solar wind) upon coronal structures.
- b) Studies of the evolution of the chromospheric network and its extension into the corona.
- c) Investigations into the evolution of solar features on a time scale of hours.

Scientific Objectives

JOP 9) Collect data from the white-light, X-ray, and XUV corona over an extended period of time.

Manned Scheduling Guidelines

JOP 9) Building Block 2 (BB-2) will be performed in each of 60 consecutive orbits by pointing the ATM at the sun's center with a ± 5400 arc minute roll orientation for S052. During 30 consecutive orbits of these 60, two BB-2's will be performed, one at the beginning and one at the end of each orbit. If, during this 60 orbit sequence, BB-1 is scheduled to obtain data on some other JOP, it is not necessary to schedule one of the BB-2 operations since the first 6.5 minutes of BB-1B is equivalent to BB-2. If a sun centered BB-28 has been scheduled, it will also satisfy the requirement for one of the BB-2 repetitions.

Data obtained in the unattended mode are necessary during those orbits when it is not possible to schedule manned operations. However, it is desirable that this JOP be scheduled during 4 consecutive days devoted primarily to ATM so that maximum data correlation can be obtained between all of the ATM experiments.

During the 60 orbit sequence, the ATM may be pointed at the limb and BB-3 or BB-28 performed for high resolution inner corona data.

Deviations from the 60 consecutive orbit sequence requirement of this JOP, such as a reduction in the total number of orbits, or some number of orbit interruptions during the sequence, must be evaluated and negotiated on a case by case basis in real time.

Unattended/Unmanned Scheduling Guidelines

JOP 9U) For those orbits of the 60 orbit sequence which must be performed unattended/unmanned, the following operation will be performed:

At ground station acquisition point the ATM to sun center and perform BB-U1.

Evaluation

JOP 9) The S052, S054, and S056 observations will provide information on
JOP 9U) the rate of expansion of various parts of the solar corona and the effects of this expansion upon coronal structure.

Studies of S054, S055A, and S056 data will provide information concerning the evaluation of the chromospheric network and its extension into the corona. S054 and S056 will provide data relating to the temporal evaluation of the inner corona.

Data Requirements

Refer to Appendix A.

Purpose and Background

Performance of the operations specified in this JOP will provide data to support:

- a) Verification of the accumulation of dust particles near the lunar Lagrange points L4 and L5, and a determination of the density and dimensions of the accumulation region.
- b) Studies of the evolution of the chromospheric network and its extension into the corona.
- c) Investigations into the evolution of solar features on a time scale of approximately one hour.

Scientific Objectives

JOP 10) Observe the vicinity of the lunar libration points L4 and L5.

Manned Scheduling Guidelines

JOP 10) Perform either Building Block 1 (BB-1) or BB-2 two times per orbit (early and late) for each orbit that the libration cloud is in the field of view (FOV) of S052.

The libration cloud is assumed to be 4.0 degrees in diameter as viewed from Skylab. Since S052 operates sun centered and its FOV is 3.2 degrees, observation should be planned for orbits where the Lagrange point passes within 3.6 degrees of sun center.

Unattended/Unmanned Scheduling Guidelines

JOP 10U) Point the ATM to sun center and perform BB-U1. Repeat the BB-U1 operation up to three times per orbit.

This sequence will be performed during the passage of L4 and L5 within 3.6 degrees of sun center.

Evaluation

JOP 10) The S052 observations will provide information on the accumulation
JOP 10U) of dust particles near the lunar Lagrange points.

Data from the S054, S055A, and S056 instruments will aid in the study of the evaluation of the chromospheric network and its extension into the corona. Temporal evolution of the inner corona will be determined from an analysis of the data generated by the S054 and S056 experiments.

Data Requirements

Refer to Appendix A.

Purpose and Background

Performance of the operations specified in this JOP will provide data to support:

- a) A search to detect phenomena in the chromosphere, chromospheric-coronal transition layer, and the corona which may be related to the 300-second oscillations observed in the photosphere.
- b) A search to detect transient phenomena in the chromosphere, chromospheric-coronal transition region, and the lower corona which may be related to the processes heating the chromosphere and the corona.

Scientific Objectives

JOP 11A) Collect data from a quiet and an active region (sunspot umbra).

JOP 11B) Collect data to map differential velocity fields in the chromosphere and corona.

Manned Scheduling Guidelines

JOP 11A) The ATM will be pointed at the region of interest and one of two sequences will be performed. One sequence consisting of Building Block 2 (BB-2), BB-18, and BB-2, if performed, will be pointed to sun center while the other consisting of BB-10, BB-18, and BB-10, if performed, will be pointed at a region of interest preferably close to sun center. It is also desirable that the region cover at least five arc minutes and ground observatories be available for concurrent data acquisition. The following will be performed:

- a) Roll to 0000 or 10800 arc minutes and perform BB-2 or BB-10 once.
- b) With the pointing and roll the same as in (a), perform BB-18 once.
- c) If the sequence containing BB-2 is used, roll to ± 5400 arc minutes and perform BB-2 once.
- d) If the sequence containing BB-10 is used, roll the S082A dispersion clear of the region and perform BB-10 once.

JOP 11B) Point the ATM at sun center and perform BB-12 once.

Unattended/Unmanned Scheduling Guidelines

JOP 11AU) The ATM will be pointed at a region of interest preferably at
JOP 11BU) the sun's center.

Perform either BB-U4, BB-U8, BB-U11, BB-U12, or BB-U13 at several successive ground station contacts. It is desirable to obtain a sun centered BB-U1 immediately prior to or following this operation.

The number and kinds of performances desired will be determined during the detail planning period each day.

Evaluation

- JOP 11A) Time dependent local density and/or temperature enhancements
JOP 11AU) associated with wave and/or heating processes may produce detectable time dependent enhancements in the intensities of EUV and X-ray spectral lines and continua observed by S054, S055A, S056, and S082A.
- JOP 11B) The differential velocities and heating effects may be obtained
JOP 11BU) between a number of features on the solar disk that are highly resolved in XUV spectroheliograms.

Data Requirements

Refer to Appendix A.

Purpose and Background

A substantial portion of the data necessary for the in-flight calibration of the S055A experiment will be acquired through the twice daily performance of the Building Block 1 (BB-1). However, performance of the operations specified in this JOP will provide the additional observations deemed necessary at the time of the flight of the NRL and HCO calibration rockets planned for launch on August 14, 1973, and August 7, 1973, respectively. Another purpose is to obtain film at the start and end of each of the S052, S054, and S056 film canisters suitable for perfecting the film processing chemistry.

Scientific Objectives

- JOP 12A) Obtain calibration data for Experiment S055A.
- JOP 12B) Obtain calibration data for Experiments S082A and S082B.
- JOP 12C) Rapidly obtain a number of nearly similar coronal images, for Experiments S052, S054, and S056 calibration purposes.
- JOP 12D) Obtain Quiet Sun Calibration data for Experiment S082B.
- JOP 12E) Obtain New Moon Calibration data for Experiment S052.
- JOP 12F) Obtain Periodic Calibration data for S055A.

Manned Scheduling GuidelinesJOP 12A) S055A Calibration

The following operations shall be scheduled for Tuesday, August 7, 1973, during the first three daylight passes after 1200 hours, Central Daylight Saving Time (C.D.T.). The launch window is 1200 - 1340 C.D.T. ATM target coordinates shall be specified in the crew update PAD. Alternate calibration launch dates will be negotiated during the daily flight planning session; these alternate launch dates are anticipated to be August 9 and August 11, 1973.

- a) Orbit #1: Perform BB-22 once. The ATM will be pointed at the center of the region scanned by the calibration rocket and rolled for S082A dispersion clear of the quiet area (and to obtain uniform emission in the S082B slit if possible).
- b) Orbit #2: Perform BB-10 once and BB-11 five times. Successive performances of BB-11 are to be at least 2 arc minutes away from the previous performance. The positions selected for observation will be located in the area scanned by the S055A calibration rocket instrument. (Note: For some performances of BB-11 the S055A grating auto scan should be performed with all seven detectors on. As zero order light approaches within 100 steps of each of detectors 3 through 7, the high voltage on that detector is to be turned off and

left off until it is 100 steps past that detector. Other experiments shown in BB-11 will not operate during this sequence. The version of BB-11 to be performed on each repetition will be specified on the crew update PAD.)

- c) Orbit #3: Perform BB-22 once. The ATM will be pointed at the center of the region scanned by the calibration rocket.

JOP 12B) S082A and S082B Calibration

The following operations shall be scheduled for Tuesday, August 14, 1973, during the last four manned daylight passes. The launch window is 1200 - 1340 C.D.T. Alternate calibration rocket launch dates will be negotiated during the daily flight planning session; these alternate launch dates are anticipated to be August 16 and August 18, 1973. As soon as possible after the NRL CALROC is launched, confirmation of launch followed by complete pointing and roll instructions will be uplinked to the flight crew.

- a) To calibrate S082A, roll ATM to uplinked angle number 1, (which will place the S082A dispersion direction parallel to that of CALROC instrument A, as flown); point to an active region within $0.7 R_{\odot}$ of the sun's center, selected so that the S055A MAR field of view will cover both active and quiet areas. Perform BB-21.
- b) To calibrate S082B, roll ATM to uplinked angle No. 2 (approx. 90° from No. 1), placing the slit tangent to the part of the limb to be studied.
 - 1) With the slit tangent to the limb, perform a limb scan; i.e., BB-13 or BB-23, truncated to observe during one full orbit.
 - 2) Upon completion of a), the ATM will be pointed along the same radial line as in a), but the positions of interest will be -25, -50, and -300 arc seconds, approximately. The exact positions are dependent on the CALROC flight and will be uplinked. Perform BB-6 once at each of the three positions.
 - 3) Point the ATM at a quiet region specified by the ATM PI's and slew Hal in a circular pattern of approximately 100 arc seconds during the S082B AUTO mode, at the same position at which the slew exposure was made on CALROC. S055A will be in the STOP mode during this time period.
 - 4) Perform one of the ATM TV data cycles as soon as possible during the 4 orbit calibration sequence. (See Section 3.2.2.2[e]).

Note: This four orbit sequence provides sufficient time after completion of JOP-12B step (b) to perform one JOP-6 BB-1.

JOP 12C) Film Canister

BB-16 will be performed with a roll orientation of ± 5400 arc minutes two times in succession, at the beginning and end of each film canister, which includes the following times:

- a) Just before the second SL-3 EVA.
- b) Just after the second SL-3 EVA.
- c) Just before the third SL-3 EVA.
- d) Just after the third SL-3 EVA (ATM unmanned).

JOP 12D) Slew Calibration

Every day, point S082B at a quiet region specified by the ATM PI's and slew H α 1 in a circular pattern with an approximate diameter of 100 arc seconds during the S082B AUTO mode. S055A will be in the STOP mode during this time period.

JOP 12E) Lunar Calibration

Perform either BB-1, BB-2, or a sun centered BB-28 two times per orbit (early and late) for each orbit any part of the new moon is in the FOV of S052.

JOP 12F) Perform BB-26 approximately every other day to obtain additional S055A calibration data while pointed at or near sun center.

Unattended/Unmanned Scheduling Guidelines

JOP 12AU) In order to obtain additional calibration data, the Principal thru Investigators will specify that either BB-U1, BB-U2, BB-U3, BB-U5, JOP 12CU) BB-U6, or BB-U7 be performed periodically throughout the unattended/ JOP 12EU) unmanned periods. The pointing coordinates will be specified by JOP 12FU) the Principal Investigators.

The number and kinds of performances will be specified during the mission.

Evaluation

JOP 12A) The data from the S055A calibration observations, when used in JOP 12AU) conjunction with the data from the rocket flights, will complement JOP 12F) Skylab mission data necessary for calibration of the S055A instru- JOP 12FU) ment.

JOP 12B) Comparison of rocket-acquired data will be used in conjunction with JOP 12BU) the data acquired on the calibration runs to calibrate the S082A and S082B instruments, and to cross-calibrate the S055A and S082A instruments.

JOP 12C) Final processing chemistry for the S052, S054, and S056 film JOP 12CU) canisters will be determined by processing of the first and last few feet of the film from each canister.

JOP 12D) The data will be used to obtain a uniform emission in the
JOP 12DU) S082B slit to establish instrument sensitivity.

JOP 12E) Calibration of the S052 instrument will be attained by photog-
JOP 12EU) raphy of the new moon when it is in the FOV of the S052
instrument.

Data Requirements

Refer to Appendix A.

Purpose and Background

Performance of the operations specified in this JOP will provide data to support:

- a) Location of celestial X-ray sources.
- b) Determination of the general characteristics of the spectra of bright celestial X-ray sources in the 3-60 Å band and 912-1350 Å region.
- c) Calibration of the UV flux of bright O, B, and A stars.
- d) Investigations of the UV flux stemming from planets, comets, supernova remnants, HII regions, Magellanic clouds and quasi-stellar objects.
- e) Determination of observation possibilities of the chromospheric and coronal EUV emission of nearby stars.
- f) Determination of the point spread function of S052, S054, S055A, and S056.

Scientific Objectives

JOP 13) Obtain and record location data on selected celestial X-ray sources.

Obtain calibration data of bright O, B, and A stars.

Observe and record data from selected X-ray sources, planets, comets, supernova remnants HII regions, Magellanic clouds and quasi-stellar objects.

Manned Scheduling Guidelines

JOP 13) The ATM will be pointed by the crewman, using the Attitude Pointing Control System, to a location previously specified by the Principal Investigators. Building Block 20 (BB-20) will be performed during the dark portion of the orbit. The BB-20 exposure times will be stated on the update PAD. However, if the ATM crewman can extend the exposure time without impacting the initiation of ATM solar observations on the next dayside pass, it is highly desirable to do so.

Data from S052 will be obtained once every five minutes during the performance of BB-20 for the purpose of more precise determination of experiment pointing during star observations.

The S055A grating selection will be made by the PI for each observation period of BB-20 and specified on the crew update PAD. This selection will not be changed during an observation period of BB-20.

A candidate list of objects to be observed by the ATM instruments for the 1950 Epoch follows. Experiments S054 and S056 are limited to observations of those objects within 18 arc minutes of the center line of the ATM canister (X can).

Priority	Source	Right Ascension (Hrs: Min: Sec)			Declination (Deg Min Sec)		
1	Sco X-1	<u>X-Ray Targets</u>			-15	32	16
2	Pup A	8	21	24	-42	39	36
3	Cygnus X1	19	56	24	35	3	36
4	Sco X-2	17	02	30	36	21	36
5	Gx9+1	17	58	36	-20	31	48
6	Nor 1	16	37	18	-53	40	48
7	Crab	5	31	24	22	0	0
8	Cygnus X2	21	42	36	38	5	0
9	Ara 1	16	41	48	-45	28	48
10	Cir X1	15	16	42	-56	58	48
11	Cas A	23	21	6	59	30	36
12	Gx3+1	17	44	36	-26	32	24
13	Jupiter	-	-	-	-	-	-
<hr/>							
A 1	Alpha Cma	<u>UV Targets</u>			-16	38	2
2	Beta Cen	14	0	17	-60	7	31
3	Gamma Vel 091 + WCB	8	8	2	-47	11	48
4	Zeta Ori Near S277	5	38	14	- 1	58	19
5	Zeta Pup Gum Nebula	8	1	49	-39	51	25
6	Beta Ori	5	12	8	- 8	15	27
7	Gamma Ori	5	22	27	6	18	49
8	Kappa Ori	5	45	23	- 9	40	51
<hr/>							
B 9	Alpha Leo	10	5	43	12	12	22
10	Beta Tau	5	23	7	28	33	47
11	Alpha Gem A	7	31	25	31	59	27
12	Delta Ori	5	29	27	- 0	19	41
13	Zeta Oph, S27	16	34	24	-10	28	11
14	Delta Sco	15	57	22	-22	28	36
15	Iota Ori	5	32	54	- 5	56	57
16	Gamma Cas	0	53	40	60	27	16
17	Beta 1 Sco	16	2	31	-19	40	17
18	Epsilon Per	3	54	29	39	51	48
19	PI Sco S1	15	55	44	-25	58	42
<hr/>							
C 20	Beta Per	3	4	55	40	45	38
21	Zeta Per	3	50	59	31	44	1
22	Gamma Peg	0	10	40	14	54	41
23	Theta Aur	5	56	18	37	12	23
24	Eta Ori	5	21	57	- 2	26	9
25	Lambda Ori A S264	5	32	23	9	54	6
26	X1 Per S220	3	55	42	35	38	43
27	Kappa Cas	0	30	9	62	39	34
28	Alpha Cam	4	49	3	66	15	16
29	15 S Mon	6	38	13	9	56	19
<hr/>							
D 30	10 Lac S126	22	37	0	38	47	35
31	Theta 1 Ori C	5	32	51	- 5	24	56
32	9 SGR M8	18	0	49	-24	22	3
33	Ae Aur IC405 = S229	5	13	0	34	15	31
34	X Per X-Ray Source	3	52	15	30	53	56
35	S2, XR1700-37	17	0	32	-37	46	34
36	Eta Carinae	10	43	7	-59	25	45

The premission flight plan is to include four passes for the observation of X-ray targets and four passes for the observation of UV targets, if possible (all to be selected from the list of targets on the previous page).

Target priority information is included as follows:

- a) The X-ray targets are listed in order of priority (1 through 13).
- b) The UV targets are divided into four priority groups, A through D, based on brightness and interest. Group A objects have the highest priority and Group D objects have the lowest priority. The UV objects also have a number (1 through 36) associated with them which indicate relative brightness (number 1 is the brightest object). The brightness number may be used to determine the relative priority of objects within one of the four priority groups (A through D).

The crewman is to utilize the on-board voice recorder to record exposure start and stop times.

Evaluation

JOP 13) The location of celestial soft X-ray sources will be determined by analysis of the simultaneous observations (during the dark portion of the Skylab orbit) of specified celestial fields by S054 and S056 in soft X-rays and S052 in visible light. This is accomplished by relating the position of the X-ray source in the field of the S054 and S056 X-ray photographs to the pointing direction of the ATM determined from white light star pictures obtained by S052. Use of various X-ray filters will indicate the spectral shape. Information on the UV flux can be obtained from S055A partial raster scans with selected wavelengths or from the integrated UV light readings, with zero order light set on one of the detectors.

Data Requirements

Refer to Appendix A.

Purpose and Background

Performance of the operations in this JOP will provide data to support:

- a) Ground based observations of the solar eclipse.
- b) Investigations into the evolution of solar features on a time scale of hours.
- c) Stray light calibration of the S052 experiment employing the moon.
- d) Determination of the edge response of the S054 instrument.

Scientific Objectives

- JOP 14A) Observe the sun prior to and after the solar eclipse.
- JOP 14B) Observe the partially occulted solar corona during the eclipse.

Unmanned Scheduling Guidelines

- JOP 12A) The ATM will be operated for 9 consecutive orbits on
- JOP 12B) June 30, 1973 with the eclipse centered on orbit 5 (approximately 11:30 GMT). Selection of the appropriate Building Blocks (BB) will be made from the unmanned BB's during the planning session.

Evaluation

- JOP 12A) Data from the S052, S054, and S055A instruments in conjunction with the ground based eclipse observations will be used
- JOP 12B) to determine the temporal evolution of the corona.

The data from S054 will allow a determination of edge response of the X-ray optics. This in turn will allow a better evaluation of instrument scattering.

Data Requirements

Refer to Appendix A.

Purpose and Background

The objective is to perform observations and to obtain temperature-density data of features known as coronal holes. In addition, data will be obtained regarding the velocity field in and around coronal holes to corroborate existing evidence of apparent solar wind enhancement over coronal holes and the resultant periodic geomagnetic disturbances.

Scientific Objectives

- JOP 15A) Observe a coronal hole on the disk.
- JOP 15B) Observe a coronal hole at the limb.
- JOP 15C) Observe the long term evolution of a coronal hole.
- JOP 15D) Observe the velocity field in a coronal hole and its surroundings.

Manned Scheduling Guidelines

- JOP 15A) A coronal hole on the disk will be selected by the crew and/or Principal Investigators (PI) and will be located on-board through the use of the XUV monitor (or observations of the MgX 625A line with the S055A detector 1 or 3 output minimized). Once located, the following operations will be carried out:
 - a) Perform Building Block 28 (BB-28) once at the center of the hole as determined by the XUV MON or PAD coordinates. Point to two other positions in the hole and perform BB-3 at each position. Thereafter, point the ATM at various positions in the hole and along the boundary, and perform sequences of BB-6 and BB-11 until at least two performances of BB-6 and at least three performances of BB-11 have been conducted.
 - b) If the hole is large, i.e., greater than 20 to 25 square arc minutes, additional performances of BB-3 may be performed.
 - c) If the hole or any part of it is outside $0.7 R_{\odot}$ then BB-2 or a sun centered BB-28 will be performed once every other orbit in addition to those operations delineated in a) or b) above. Performance of BB-2 or a sun centered BB-28 will allow observation of the corona above the hole.
 - d) For BB-3 and BB-6B, roll to clear the S082A dispersion of the coronal hole; for BB-2 or BB-28 (with S052) roll to locate the S052 pylon opposite the coronal hole and, if possible, to clear the S082A dispersion; for BB-11 and BB-6A, S082B controls the roll; for BB-28 (without S052), S082A or S082B controls the roll.
- JOP 15B) A coronal hole that is crossing the limb will be selected for study by the crew and/or Principal Investigators. The hole will be located through use of the XUV monitor or coordinates supplied by the ground. At the location of the hole BB-13

or BB-23 should be performed once. In addition two pointings at about 10 to 20 arc seconds above the limb in the corona should be made with one performance of BB-6 and one performance of BB-11 being made at each location. One performance of BB-2 or sun centered BB-28 every other orbit should also be scheduled.

- JOP 15C) The evolution of a coronal hole will be studied by monitoring its development every day for at least 10 days with one performance of BB-3 or BB-28 and one performance of BB-2 or sun centered BB-28 each day. The BB-2 performance will be discontinued when no part of the hole is outside $0.7 R_{\odot}$.
- JOP 15D) For the velocity study the hole will be observed with BB-10, BB-19, and BB-10 in that order, all performed within the same orbit. In the BB-10 performances S055A will be in MAR; in BB-19 the S055A line scan should cross both the hole and the surrounding area. The roll attitude for either BB-19 or one of the two BB-10 performances should be 0000 or 10800.

Evaluation

- JOP 15A) Information on the three dimensional structure of the coronal
 JOP 15B) hole will be obtained by X-ray filtergrams from S054 and
 JOP 15C) S056 and spectroheliograms from S055A and S082A. Detailed information on the variation of temperature and density as a function of height will be obtained through a combination of filtergrams and spectroheliograms and S052 white light photographs, as well as through use of EUV spectra taken by S055A and S082B.
- JOP 15D) Velocities will be determined by spectra line shapes with S082B and spectra line shifts with S055A.

Data Requirements

Refer to Appendix A.

Purpose and Background

This JOP supplements the observations of active regions (JOP-2), flares (JOP-3) and prominences (JOP-4) by focusing attention on events with intensity variations occurring on a time scale of 30 to 50 minutes which are not associated with activity sufficient to trigger the flare alarm. The objectives are:

- a) Investigate the origin of transient phenomena, their temporal and spatial evolution, and their correlation with flares and other solar activity.
- b) Determine the correlation of disk transients as observed in visible light and at radio wavelengths with their EUV and X-ray manifestations.
- c) Determine the velocity of propagation of disturbances parallel and perpendicular to the photosphere.
- d) Map the fine structure within the transient and in the surrounding region.

Scientific Objectives

JOP 16) Observe disk transients (disappearing filaments, winking filaments and surges) within $0.7 R_{\odot}$ of sun center.

Manned Scheduling Guidelines

If a disk transient occurs, and the transient guidelines specify that ATM JOP-16 may be run, the crewman is to delete scheduled ATM operations and initiate ATM JOP-16. ATM JOP-16 may also be initiated via a voice request from the ground.

JOP 16) SO55A will generally be operated in the Mirror Line Scan mode using the polychromatic grating position, however, the PI's or crewman will decide on the use of the Mirror Auto Raster mode as an alternative based on the time scale observed.

Point the ATM at a disappearing filament, winking filament, or surge within $0.7 R_{\odot}$ of sun center and perform Building Block 7 (BB-7). Repeat BB-7 at least 3 times. If the transient is still visible, continue for the duration of the transient or until instructed by the ground to terminate ATM JOP-16 operations. Missing BB-7 information will be included on the daily update PAD to the crewman.

Evaluation

JOP 16) The data obtained will be used to determine the origin of transient phenomena and their temporal and spatial evolution and correlation with flares and other solar activity; the correlation of disk transients observed in visible light and at radio wavelengths with their EUV and X-ray manifestations; the velocity of propagation of disturbances parallel and

perpendicular to the photosphere; and the mapping of the fine structure within the transient and surrounding region.

Data Requirements

Refer to Appendix A.

Purpose and Background

Two (possibly related) types of small, bright spots have been observed. In the rocket spectroheliogram images of He II (304Å), they appear to be in network boundaries. It is not presently known whether all XUV bright spots observed at other wavelengths are in the network. The spectroheliograms show that the spots are no larger than 10 arc seconds in diameter and may be as small as 3 to 4 arc seconds. Similar bright spots have been observed in OSO-7 heliograms (160 - 650 Å). These are very small, and at least some of them persist for periods of days.

The X-ray coronal bright spots have been associated with (1) small bipolar regions immersed in unipolar magnetic regions on the quiet sun, (2) with some bright features in the CaK network, and (3) with other indicators of strong magnetic fields in the quiet regions.

It is not presently known whether the XUV bright spots observed by NRL correlate with X-ray bright spots or the intense bipolar fields observed on magnetograms.

The XUV bright spots observed by NRL have not been correlated to Ca II K or H α observations.

Scientific Objectives

- JOP 17A) Observe structure of an XUV bright spot.
- JOP 17B) Observe the short term evolution of a bright spot.
- JOP 17C) Observe the long term evolution of a bright spot.
- JOP 17D) Observe the structure of an X-ray bright spot.

Manned Scheduling GuidelinesJOP 17A) Structure of an XUV bright spot

Using downlinked XUV images and high sensitivity magnetic ground observations, the Principal Investigators will select a bright spot for observation by the crew. Onboard confirmation of this ground-selected bright spot will be attempted by observing the bright spot with S055A detector number 1 or 3 output after locating the spot on the XUV monitor.

During two consecutive orbits:

- 1) Point the ATM to the bright spot. Roll S082A dispersion optimal for bright spot. In addition, attempt to roll for minimum emission, other than from the bright spot, in the S082B slit. Maximize S055A detector number 1 or 3. Perform Building Block 11 (BB-11).
- 2) Point the ATM 10 arc seconds left of the maximized bright spot. Maintain the same roll orientation as in (1) and perform BB-3.

- 3) Maintain the same pointing and roll as in (1), repeat BB-3.
- 4) With the same roll orientation as in (1), point to a position 5 arc seconds left of the maximized bright spot, and perform BB-6A.
- 5) Maintain the same roll orientation as in (1), point to the center of the maximized bright spot, and perform BB-11.
- 6) Maintain the same roll orientation as in (1), point 5 arc seconds to the right of the bright spot, and perform BB-6.
- 7) Maintain the same roll orientation as in (1), point 10 arc seconds to the right of the bright spot and perform BB-11.

JOP 17B) Short term evolution

An XUV bright spot will be selected for viewing. The ATM will be pointed at a bright spot (using the XUV monitor and S055A detector number 1 or 3 output) with S082A controlling the roll orientation and BB-3 will be performed nine times. If the first orbit during which BB-3 is performed is designated as N, then the remaining 8 performances will occur on orbits N+1, N+2, N+4, N+6, N+10, N+14, N+22, and N+30. (Note: Some unattended operation will be required to accomplish this performance schedule; however, unattended operation is to be minimized.)

During successive pointings, the S082B slit will be placed on the center of the XUV bright spot.

JOP 17C) Long term evolution

Perform BB-3 or BB-6 twice per day for the life of the bright spot or until limb passage. For each performance, the S082B slit will be centered on the XUV bright spot.

JOP 17D) X-ray bright spot in the network

Using high resolution and high sensitivity magnetic and Ca II ground observations, the Principal Investigators will select a bright spot for observation by the crew. Roll S082A dispersion optimal for bright spot and also for minimum extra-neous emission of the S082B slit. The ATM is to be pointed at the bright spot by maximizing S055A detector output for a specific coronal line (to be supplied on the update PAD).

During two consecutive orbits:

- a) Point the ATM 10 arc seconds left of the maximized bright spot and perform BB-3.
- b) Maintain the same pointing and roll as in (a), repeat BB-3.

- c) With the same roll orientation as in (a), point to a position 5 arc seconds left of the maximized bright spot, and perform BB-6.
- d) Maintain the same roll orientation as in (a), point 5 arc seconds to the right, and perform BB-11.
- e) Maintain the same roll orientation as in (a), point 5 arc seconds to the right of the bright spot, and perform BB-6.
- f) Maintain the same roll orientation as in (a), point 10 arc seconds to the right of the bright spot, and perform BB-11.

Evaluation

JOP 17A) Information about three dimensional structure of XUV bright spots
thru
JOP 17D) will be obtained from S054, and S056 X-ray filtergrams, and
spectroheliograms from S082A and S055A. The spectra obtained
by S055A and S082B will provide information concerning the
temperature, density, and velocity as a function of height.
Observations obtained at a rate compatible with the time scale
of development of the region will be used for evolutionary
studies.

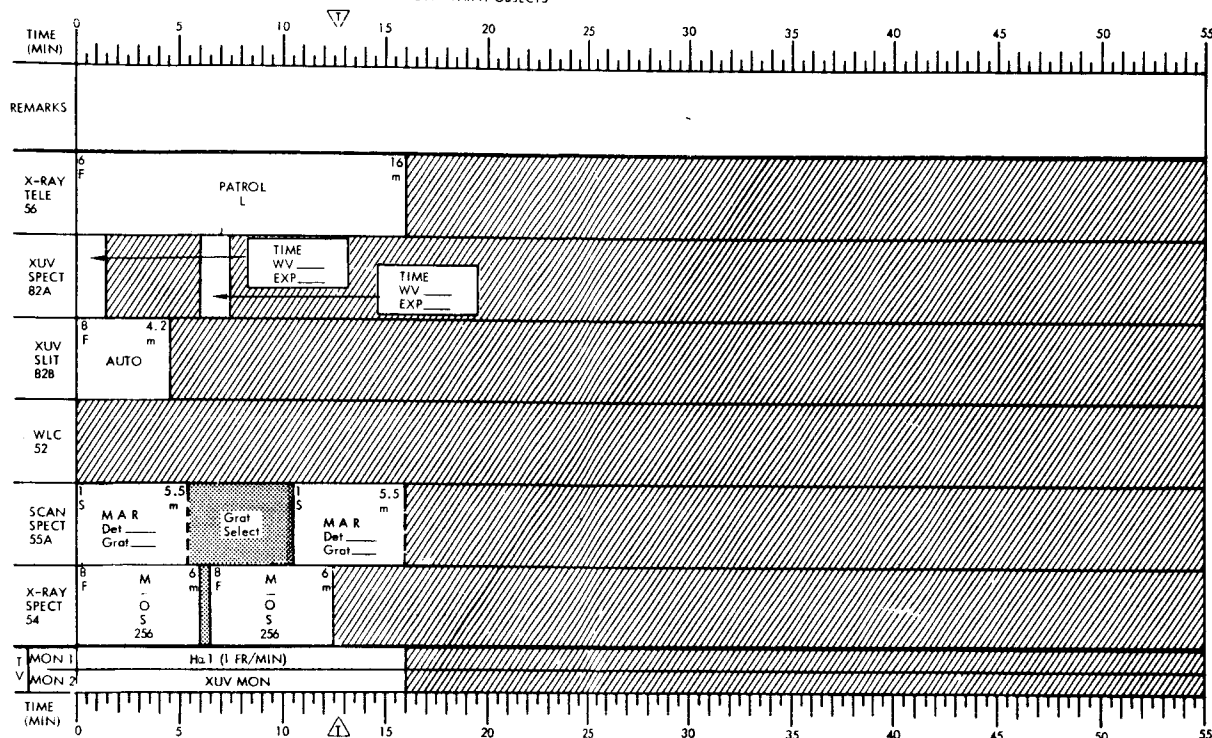
Data Requirements

Refer to Appendix A.

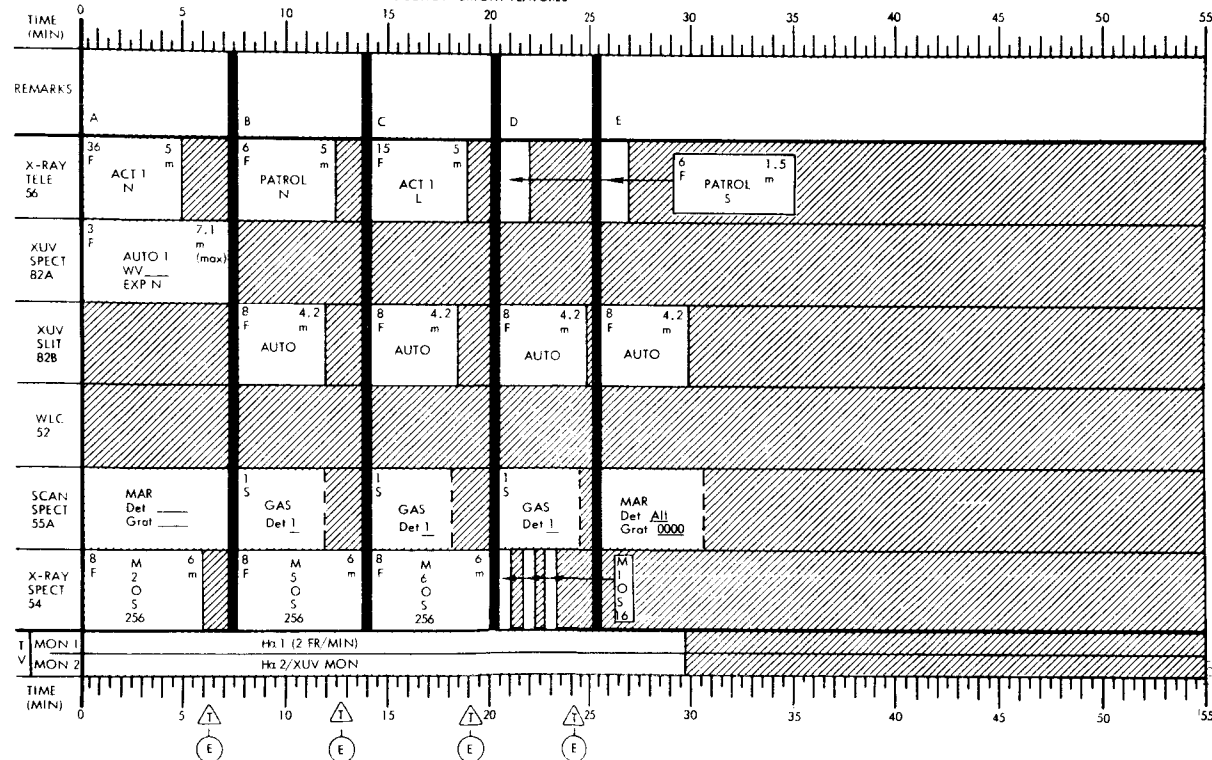
Section 3.2.2.5

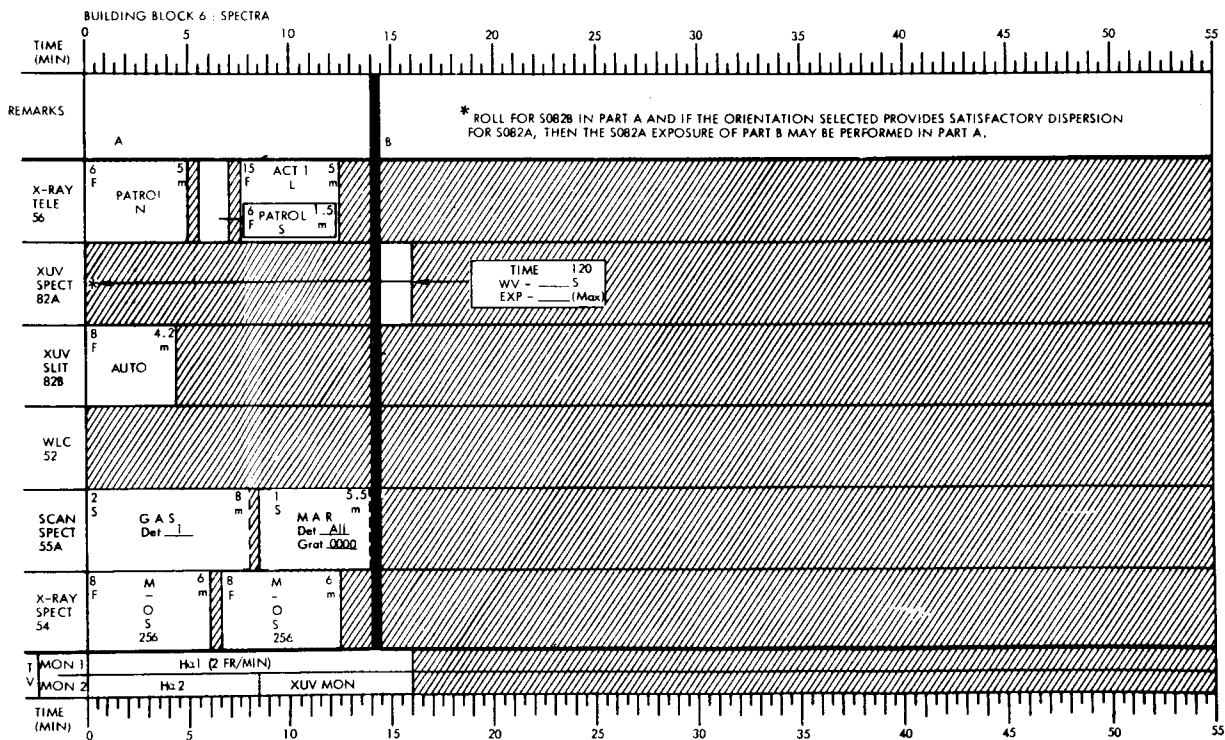
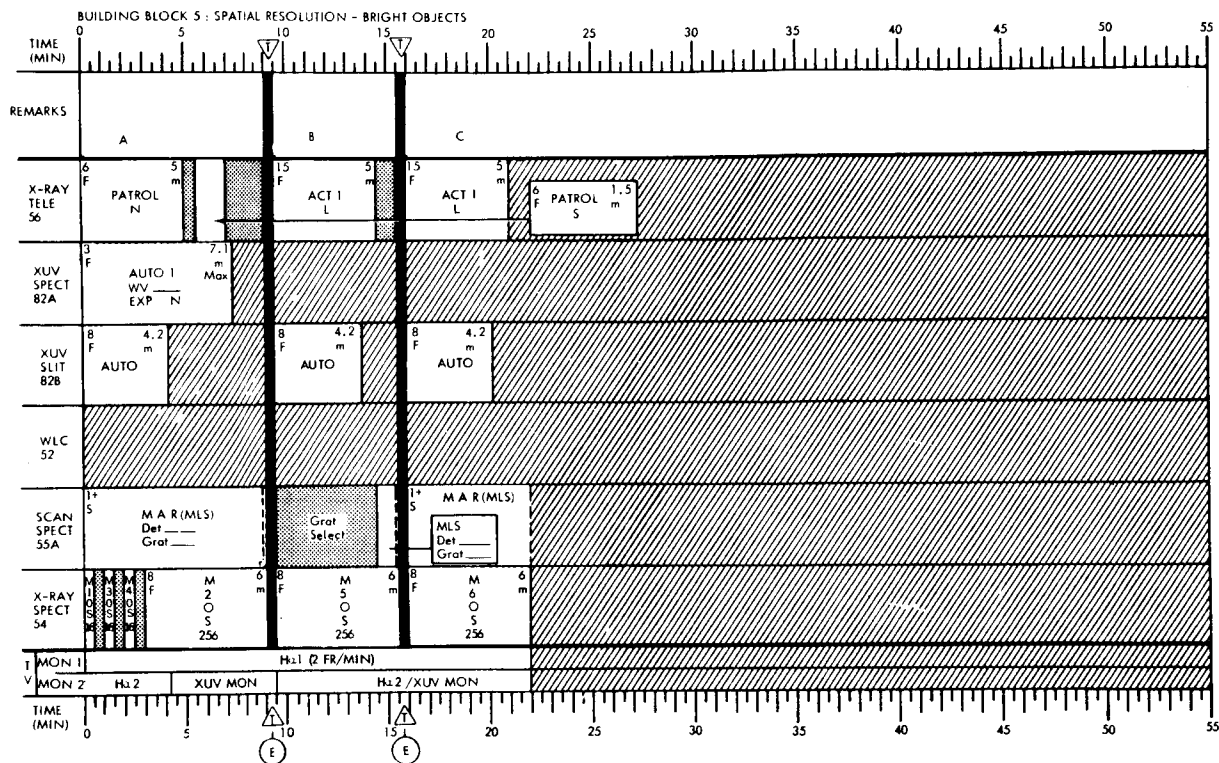
Manned Building Blocks

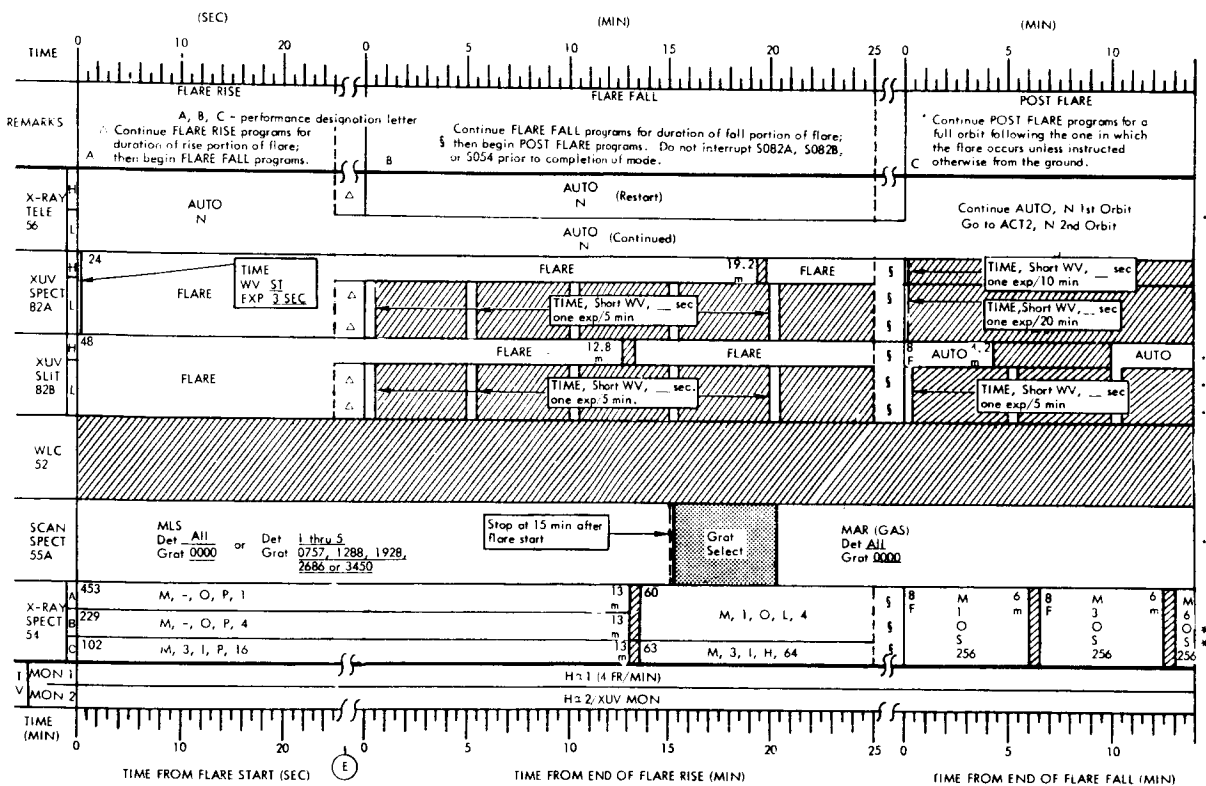
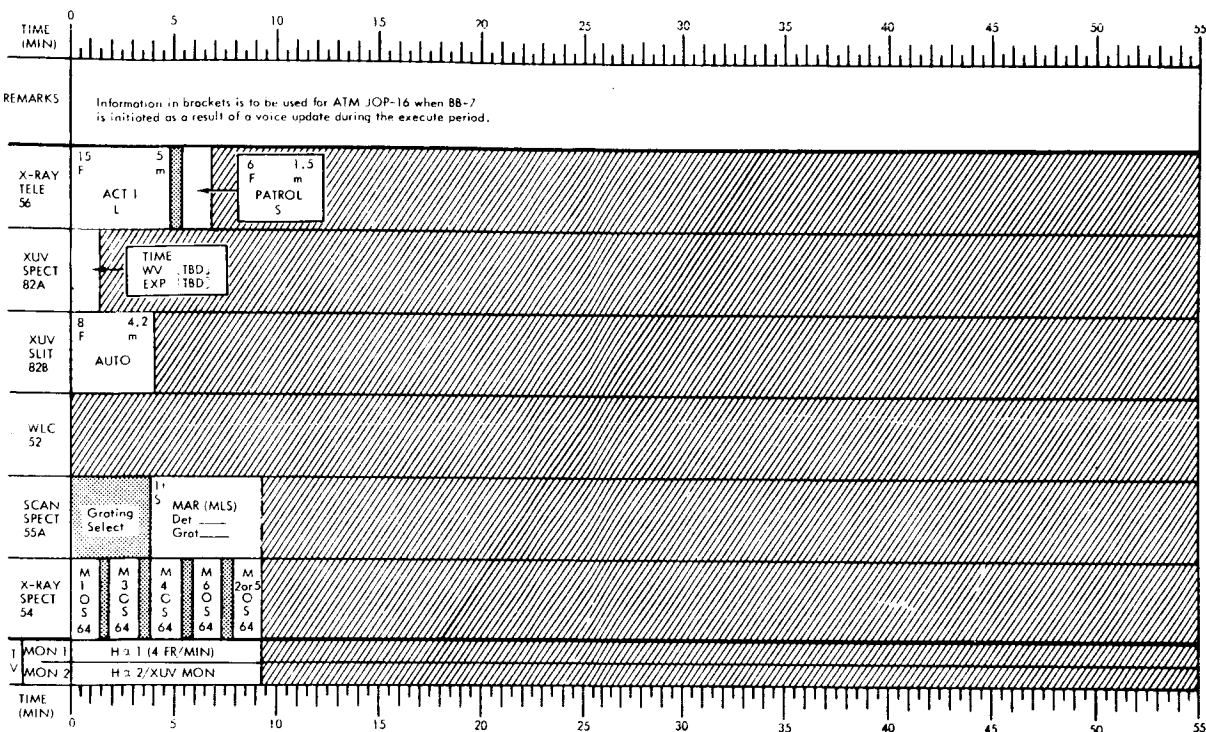
BUILDING BLOCK 3: QUIET SUN - SPATIAL RESOLUTION - FAINT OBJECTS



BUILDING BLOCK 4: SPATIAL AND SPECTRAL RESOLUTION-BRIGHT FEATURES



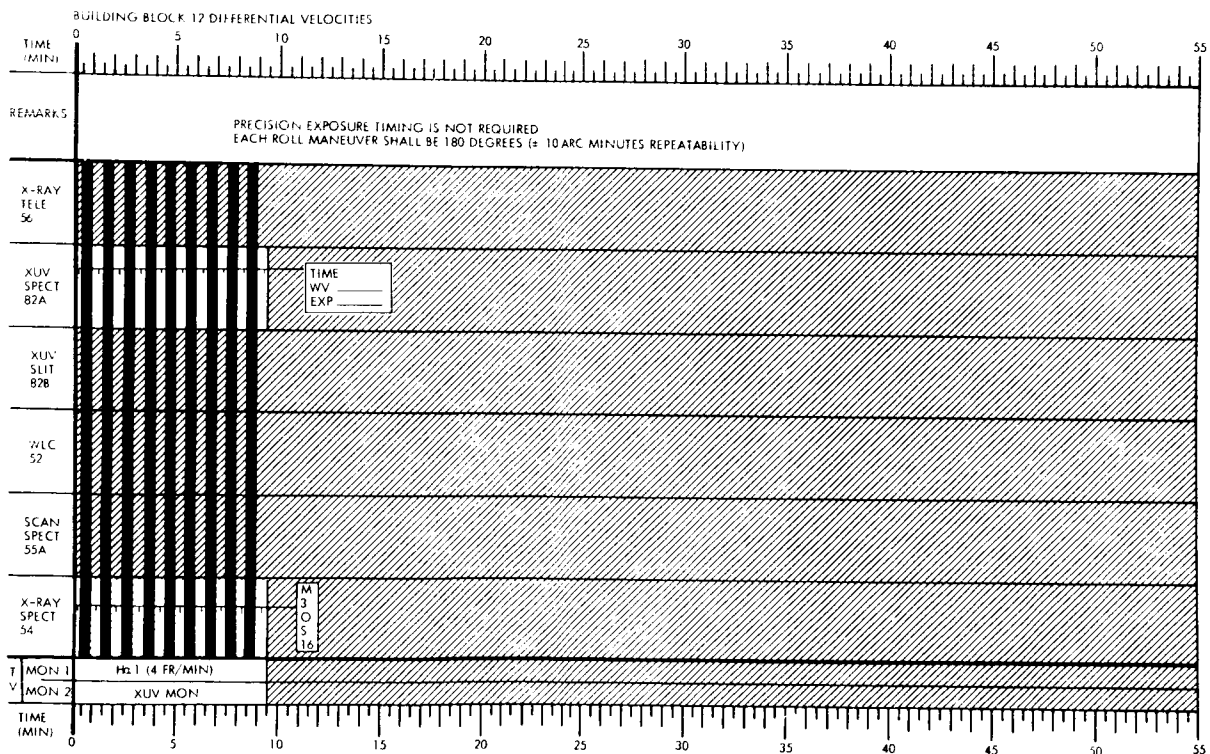
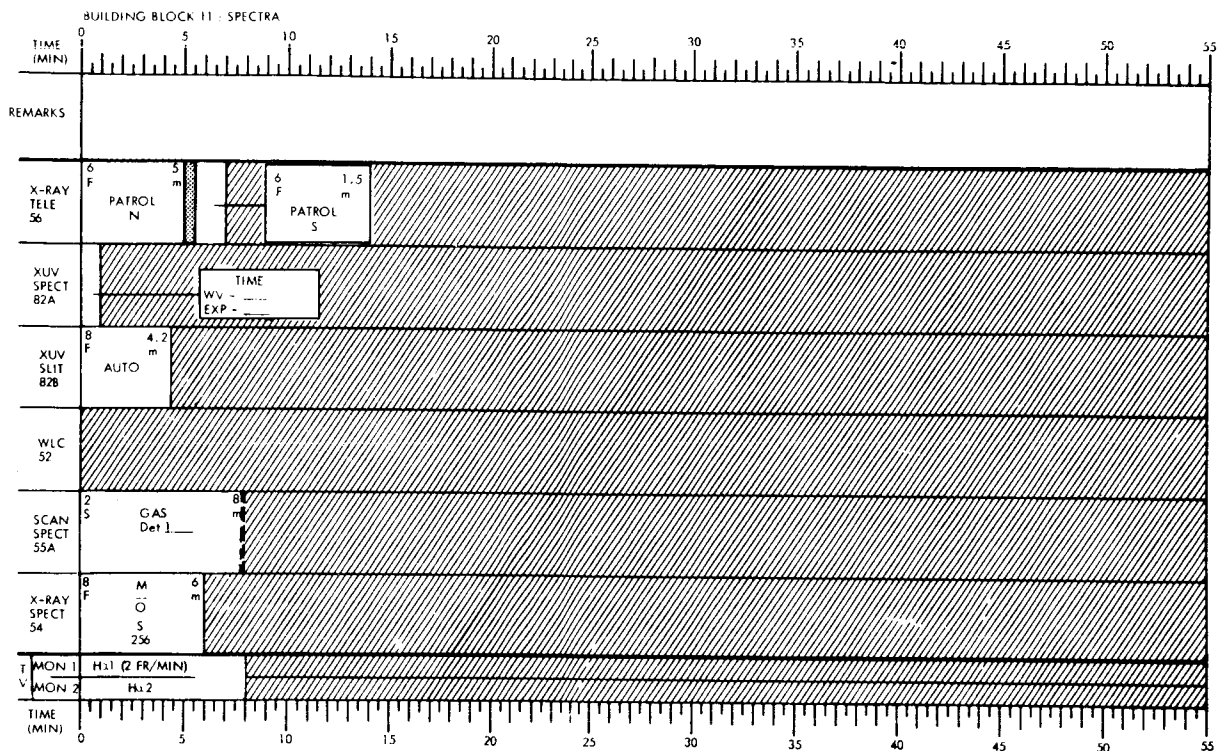


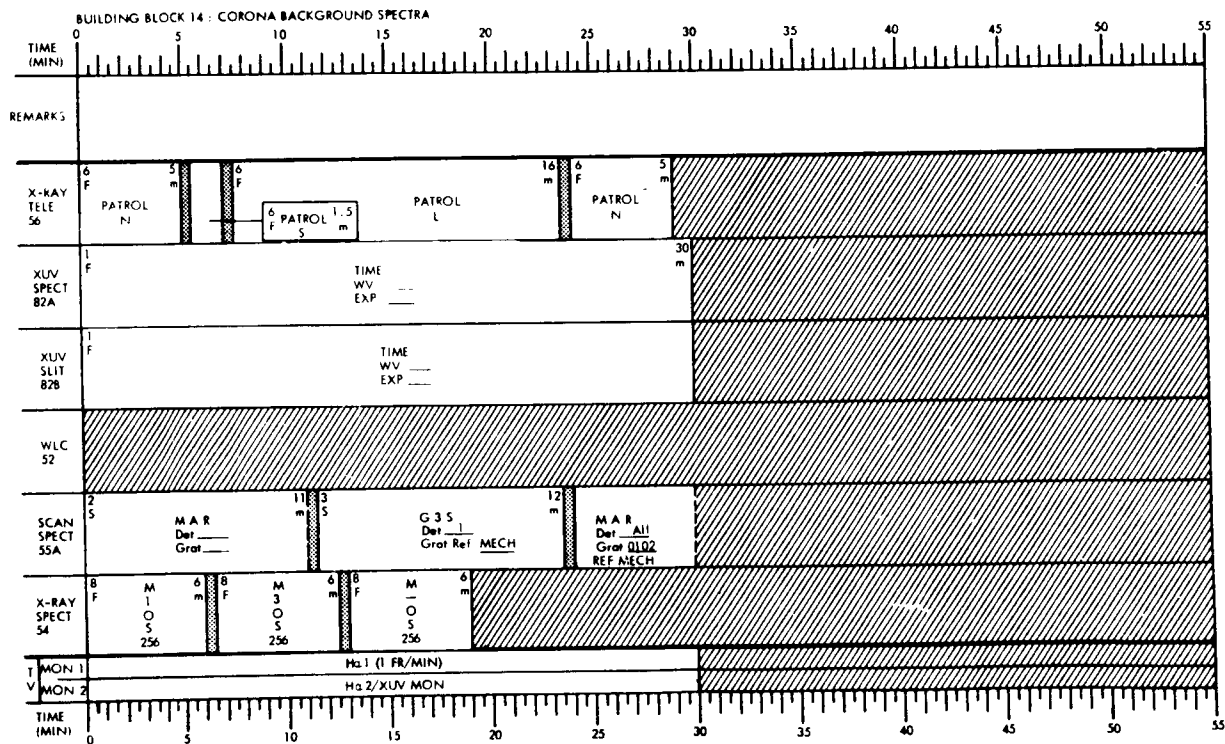
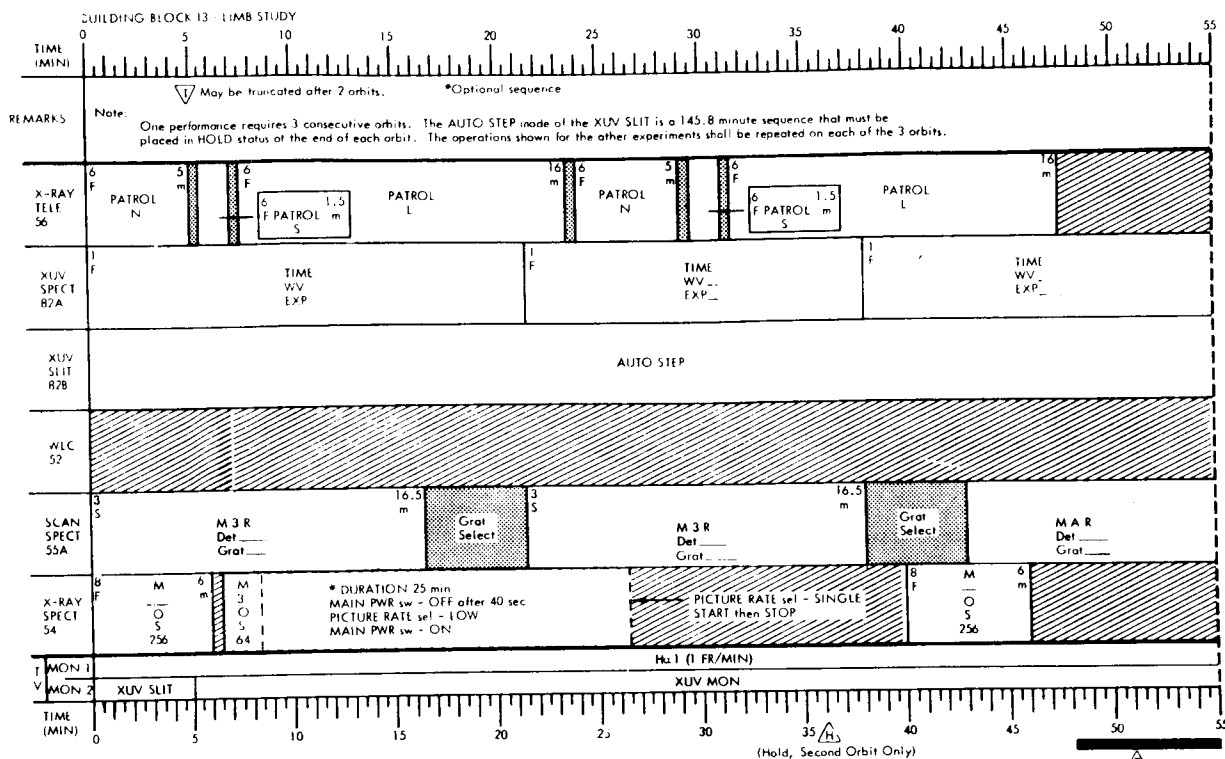


** Repeat S054, 3 filter post flare sequence for the duration of BB-8 post flare

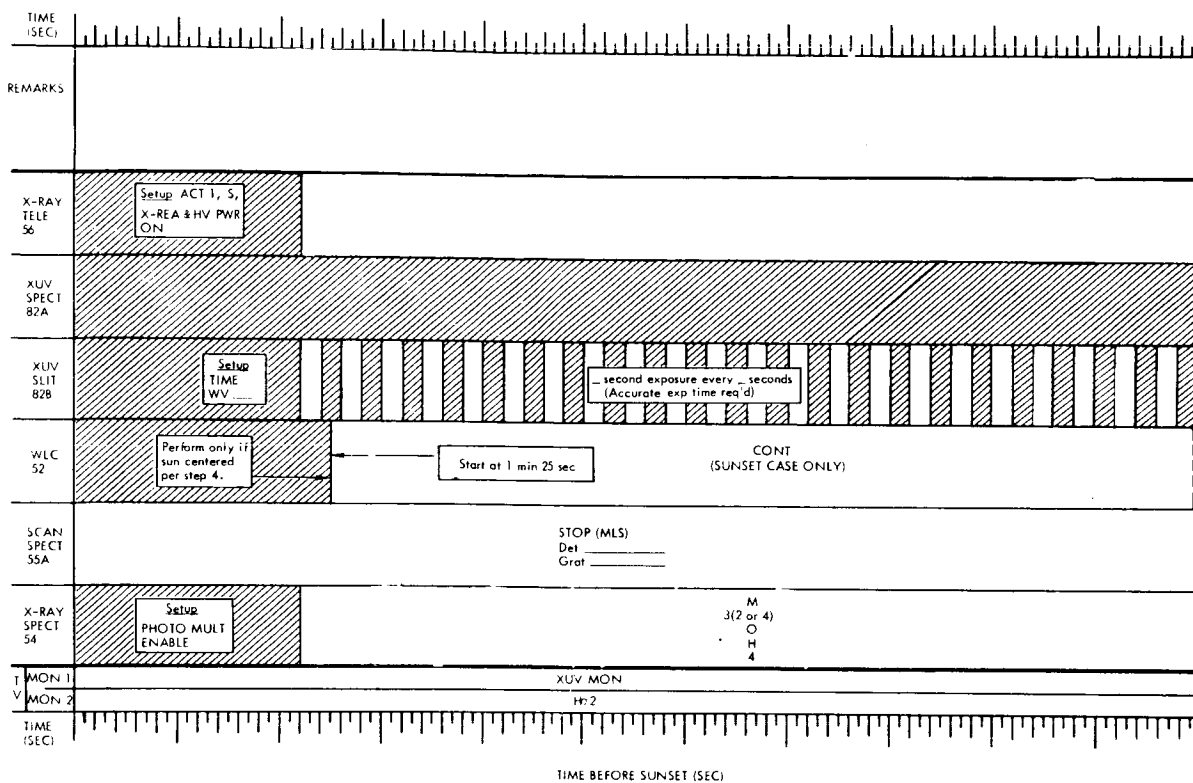
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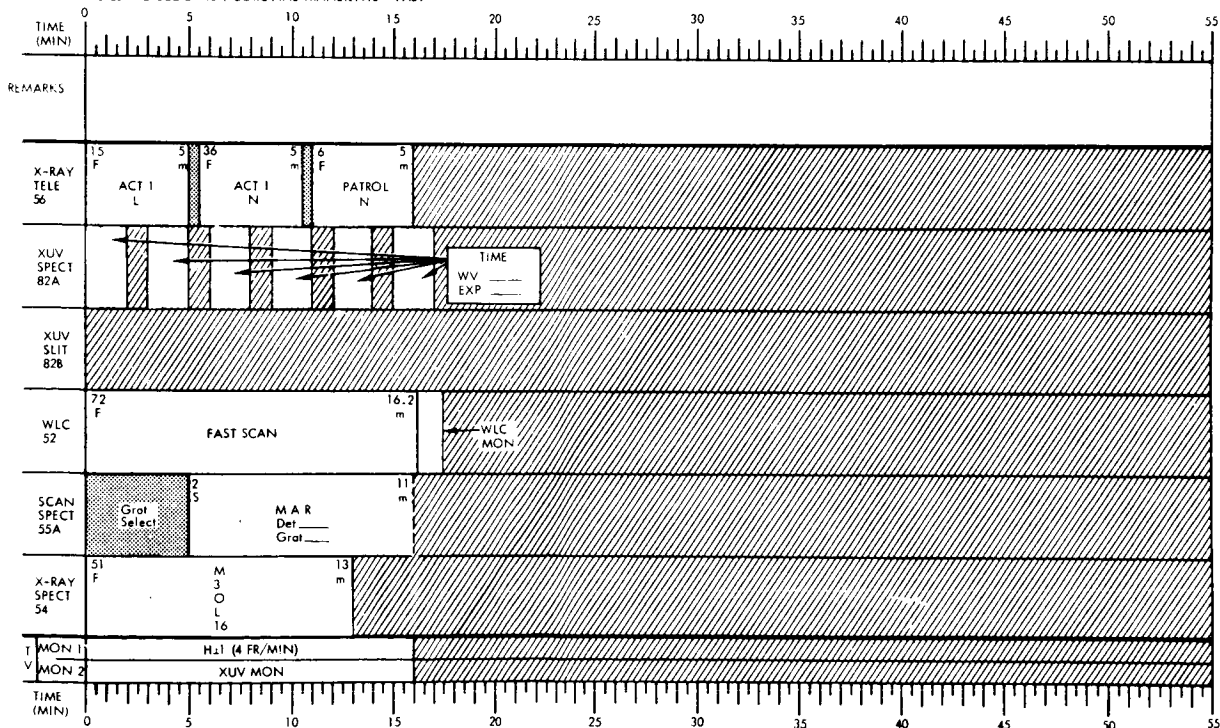


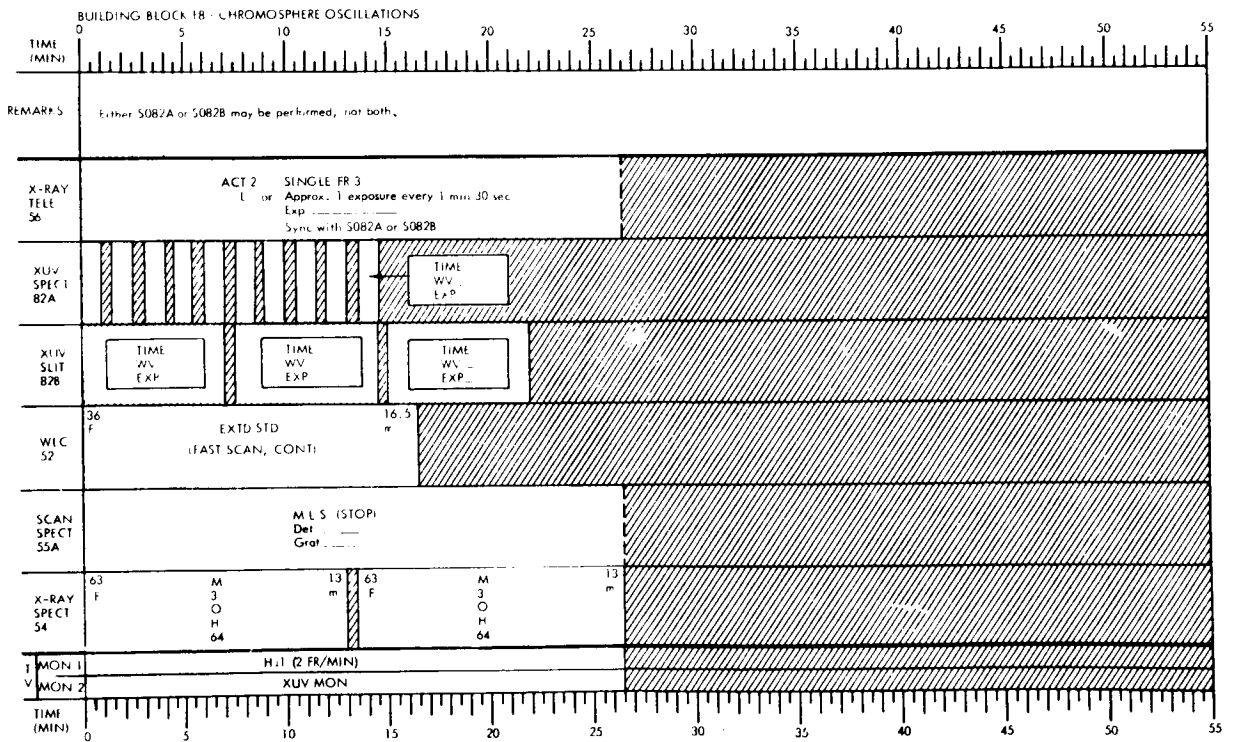
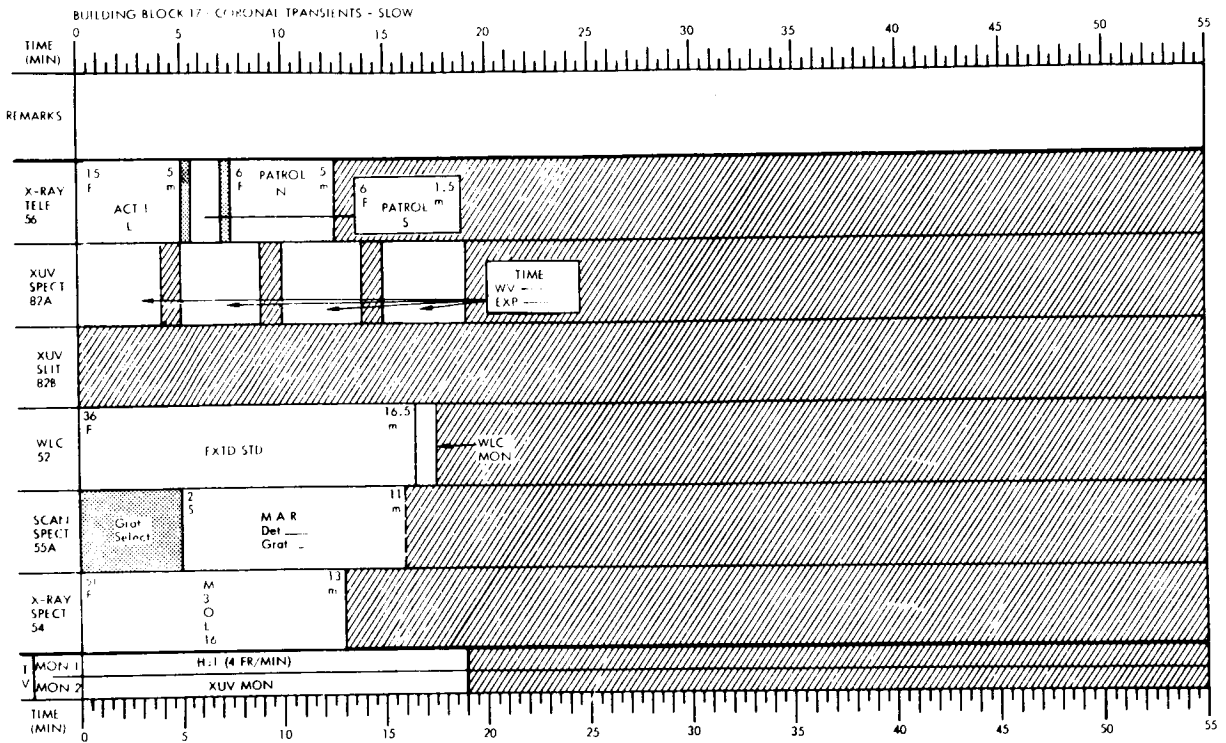


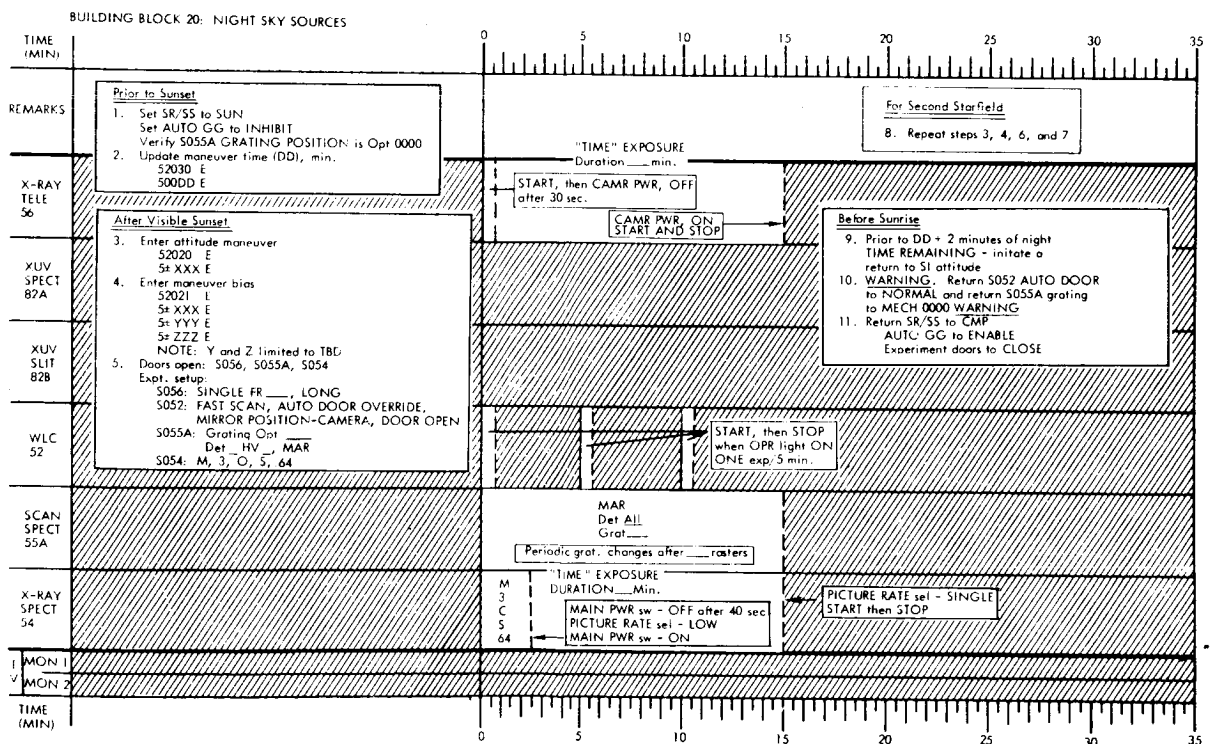
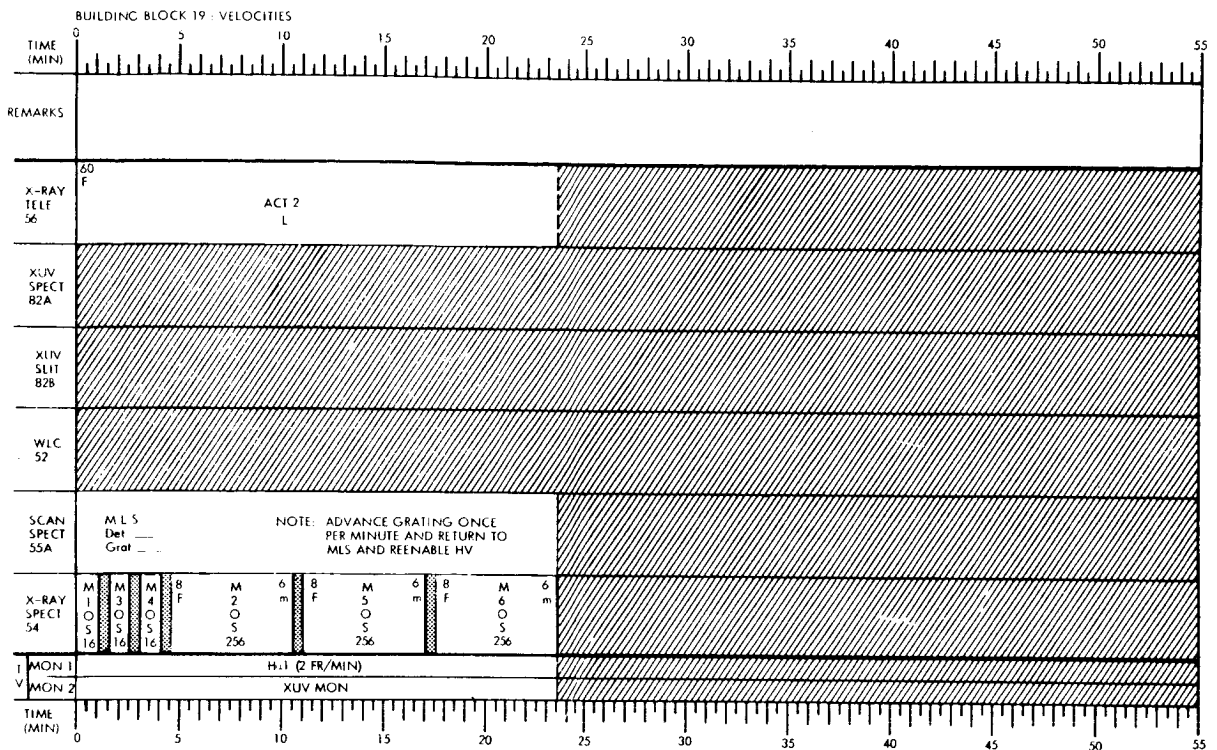
BUILDING BLOCK 15: ATMOSPHERIC EXTINCTION

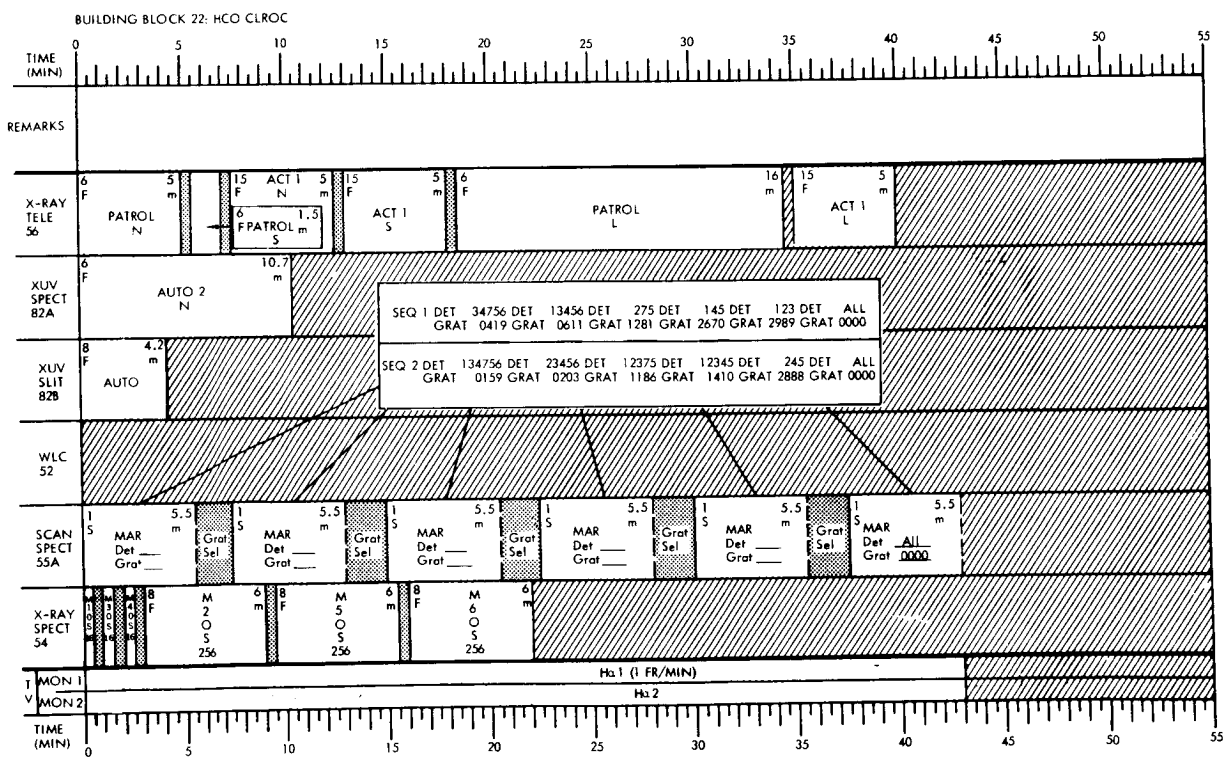
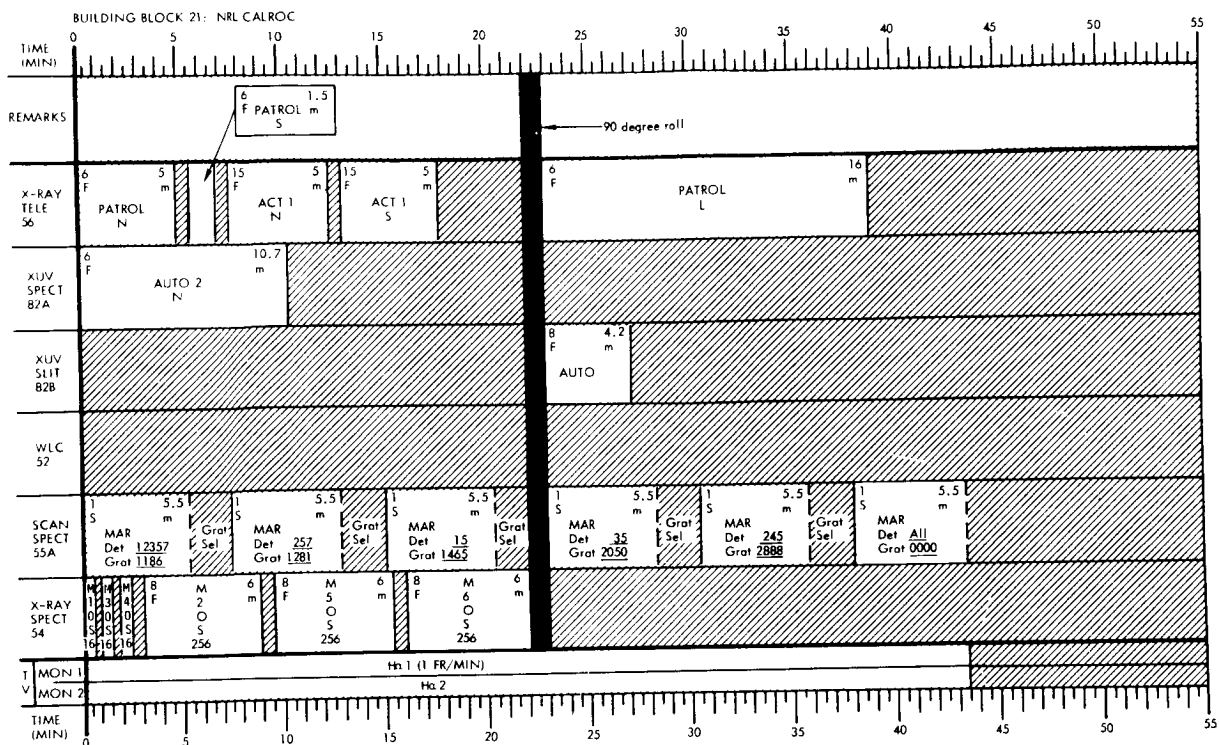


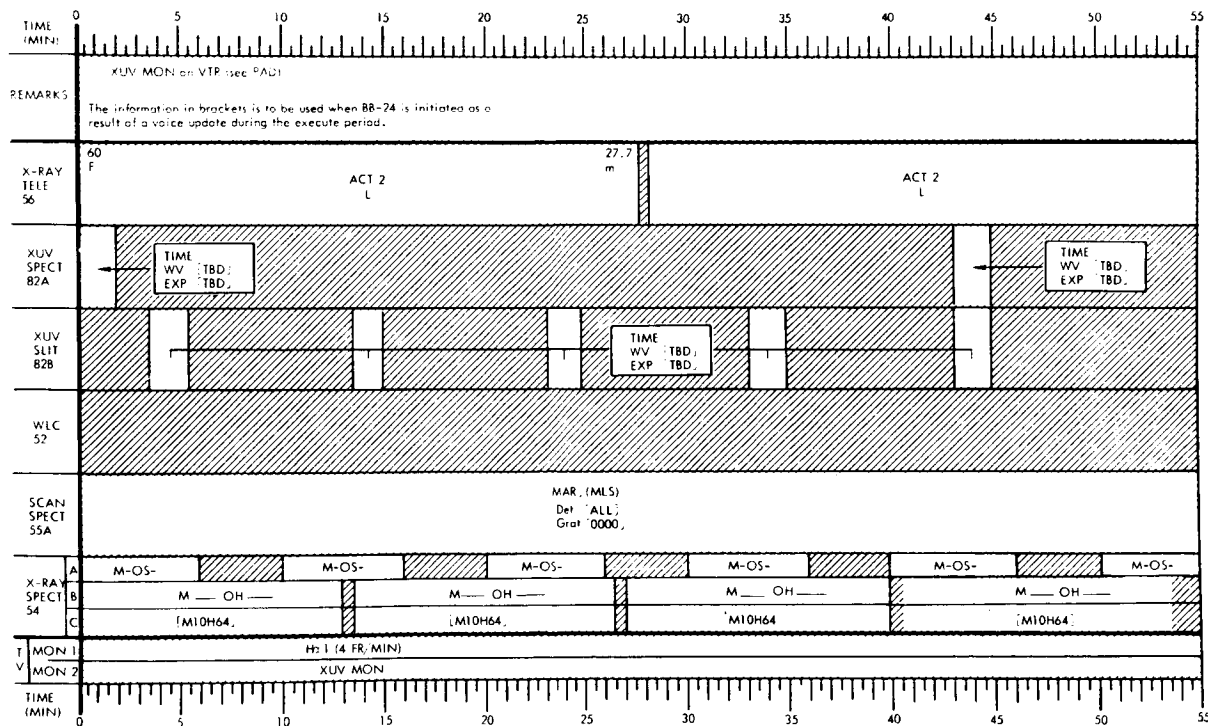
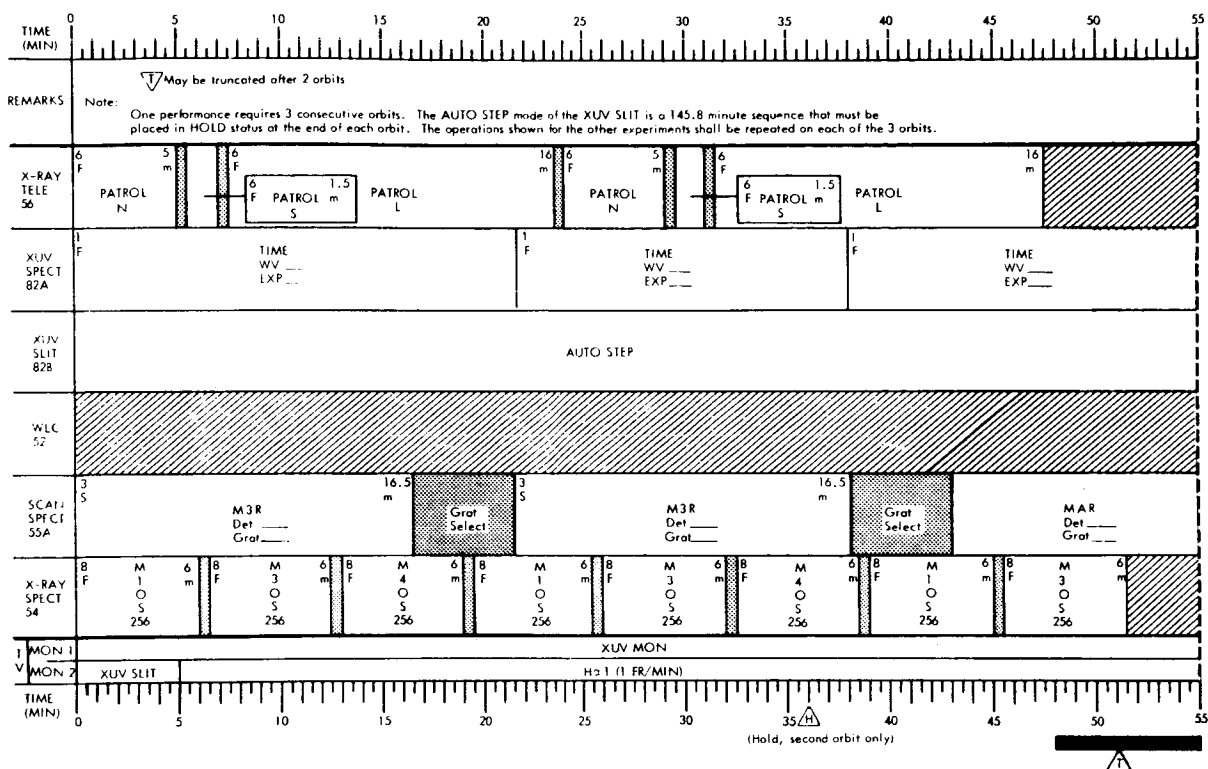
BUILDING BLOCK 16: CORONAL TRANSIENTS - FAST

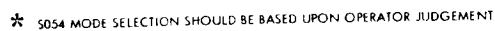


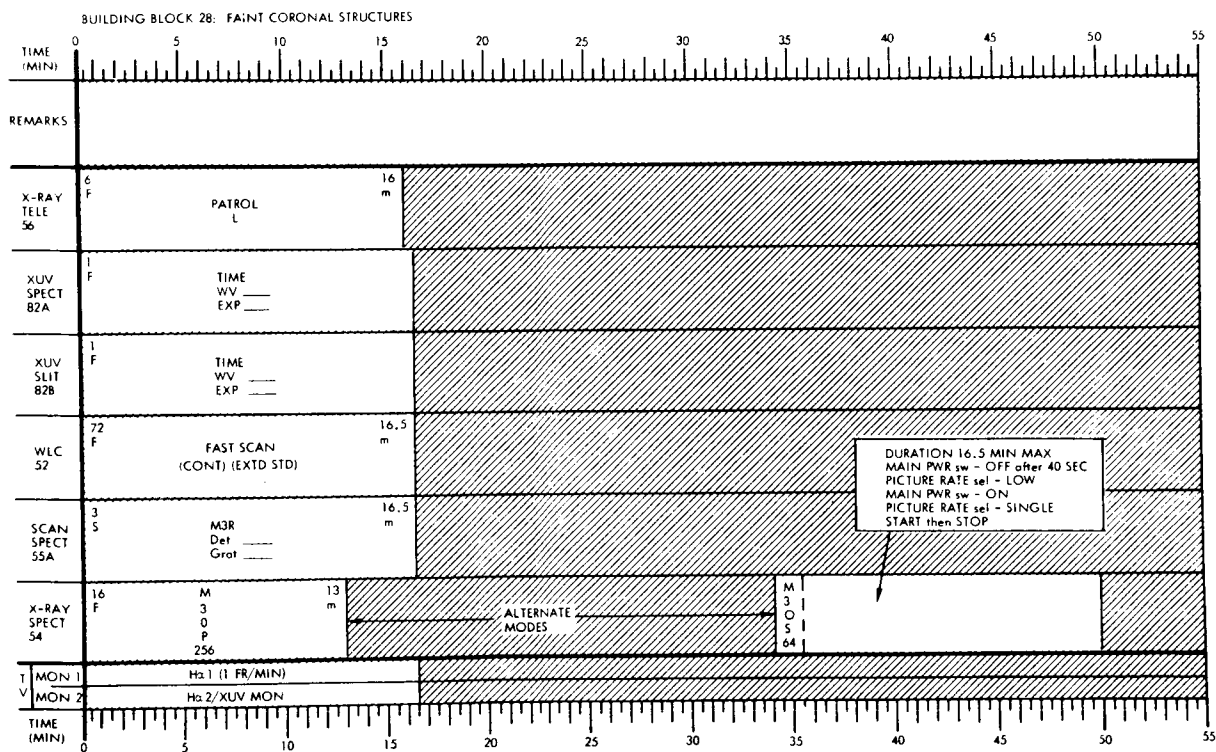
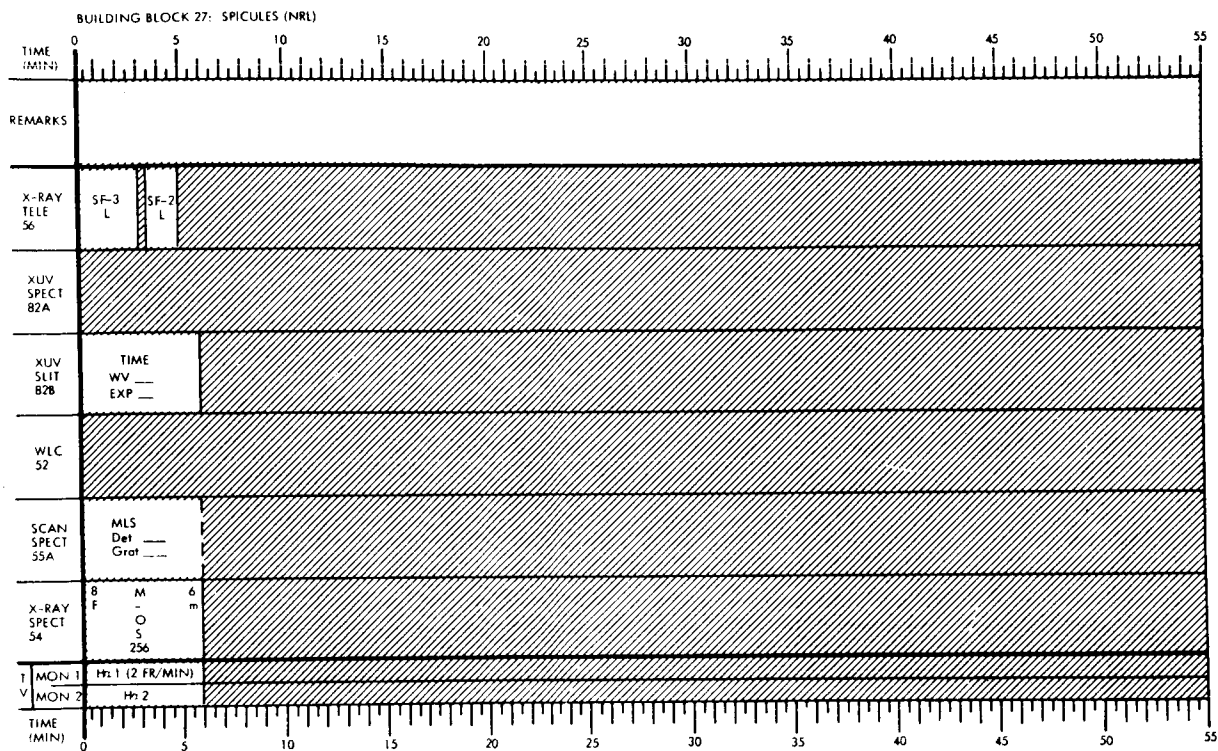






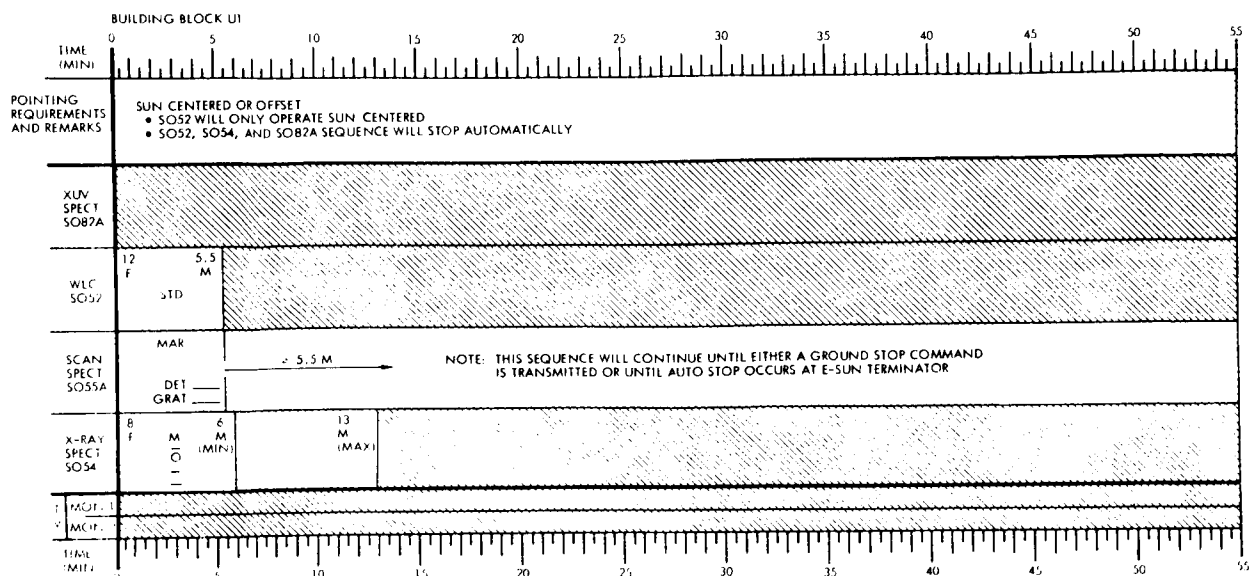




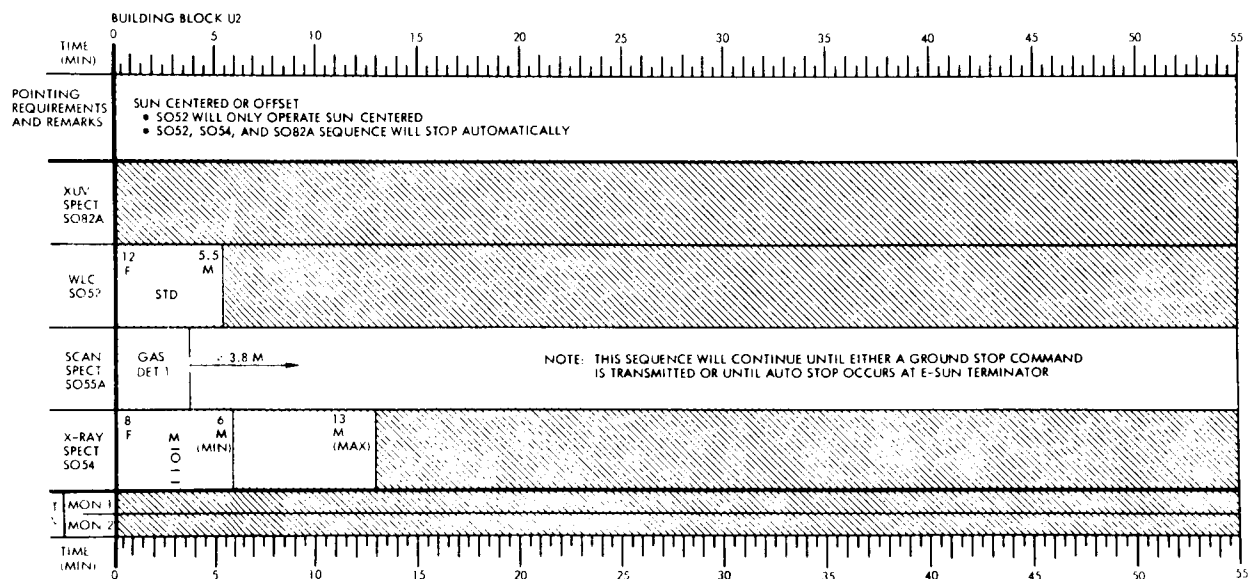


Section 3.2.2.6

Unattended Building Blocks

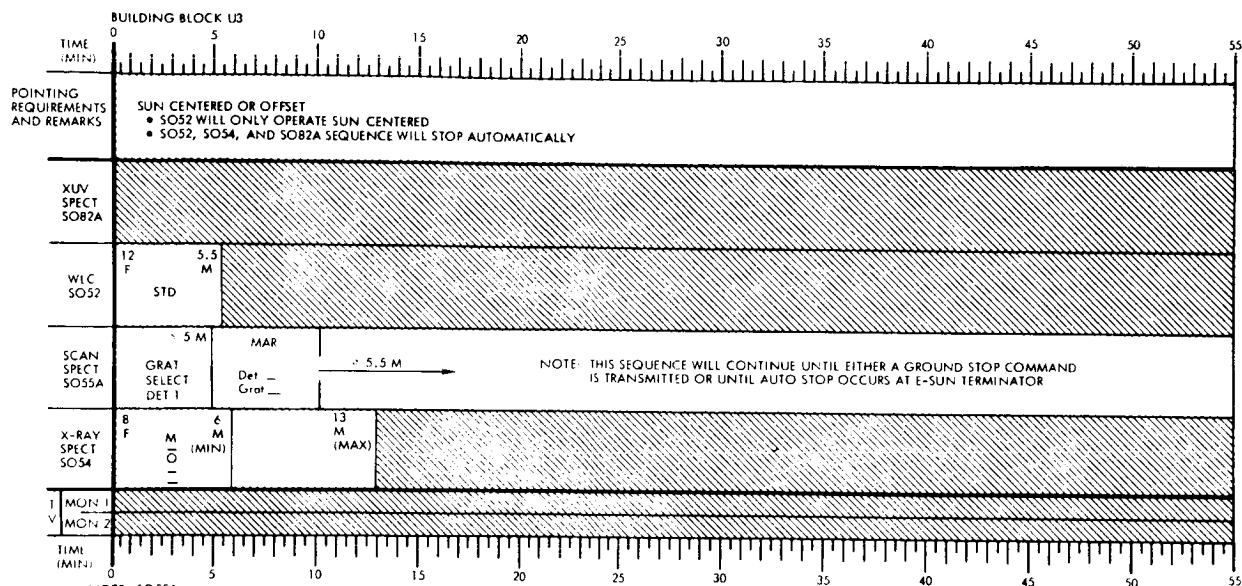


- NOTE: SOS5A -
- DETECTOR NUMBER AND GRATING POSITION WILL BE SELECTED DURING DETAIL PLANNING PERIOD EACH MISSION DAY AND COMMANDED FROM THE GROUND.
 - WILL AUTO START AT E-SUN TERMINATOR NEXT ORBIT UNLESS INHIBITED OR UNLESS NEW MODE IS SELECTED AND COMMANDED PRIOR TO TERMINATOR.
- SOS4 -
- ANY FILTER POSITION MAY BE SELECTED, BUT ONLY FILTER NUMBER 1, 2, OR 3 MAY BE GROUND COMMANDED. FILTER NUMBER SELECTED WILL BE INCLUDED ON CREW PAD FOR C&D UNATTENDED OPERATIONS SET-UP.
 - EXPOSURE RANGE SWITCH POSITION AND PICTURE RATE SWITCH POSITION WILL BE DEFINED DURING THE DETAIL PLANNING PERIOD EACH MISSION DAY AND WILL BE INCLUDED ON CREW PAD FOR C&D UNATTENDED OPERATIONS SET-UP. FOR UNMANNED OPERATIONS THE EXPOSURE RANGE SWITCH WILL BE SET TO 256 AND THE PICTURE RATE SWITCH WILL BE SET TO SINGLE (S).



- NOTE: SOS5A -
- VERIFY THAT DETECTOR 3-7 IS OFF BEFORE OPERATING.
 - WILL AUTO START AT E-SUN TERMINATOR NEXT ORBIT UNLESS INHIBITED OR UNLESS NEW MODE IS SELECTED AND COMMANDED PRIOR TO SUN RISE TERMINATOR.

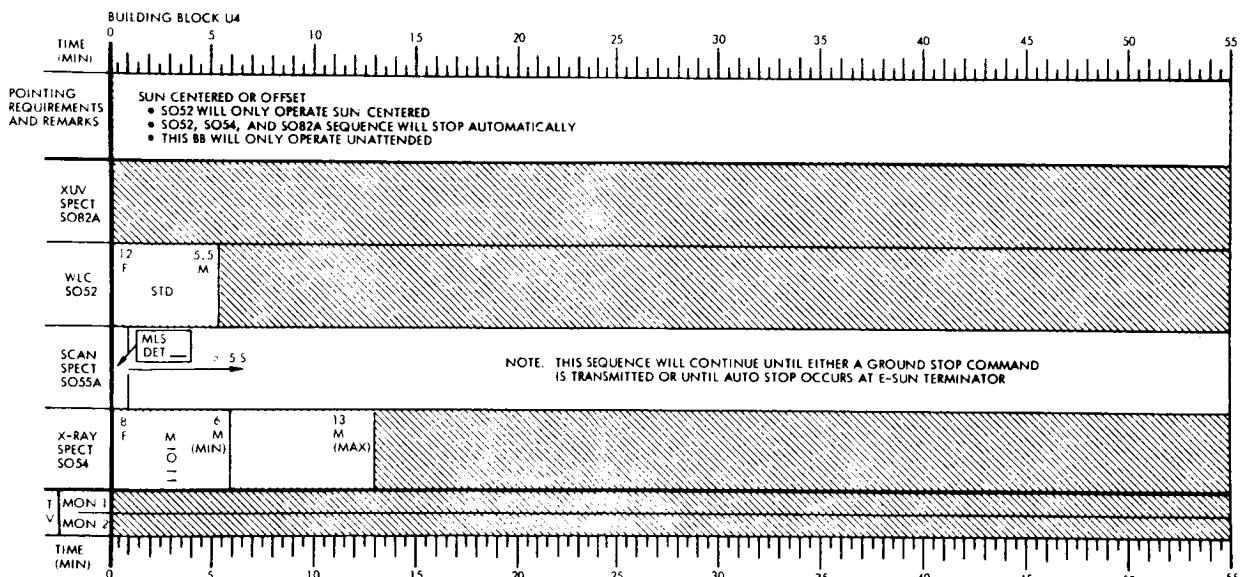
- SOS4 -
- ANY FILTER POSITION MAY BE SELECTED, BUT ONLY FILTER NUMBER 1, 2, OR 3 MAY BE GROUND COMMANDED. FILTER NUMBER SELECTED WILL BE INCLUDED ON CREW PAD FOR C&D UNATTENDED OPERATIONS SET-UP.
 - EXPOSURE RANGE SWITCH POSITION AND PICTURE RATE SWITCH POSITION WILL BE DEFINED DURING THE DETAIL PLANNING PERIOD EACH MISSION DAY AND WILL BE INCLUDED ON CREW PAD FOR C&D UNATTENDED OPERATIONS SET-UP. FOR UNMANNED OPERATIONS THE EXPOSURE RANGE SWITCH WILL BE SET TO 256 AND THE PICTURE RATE SWITCH WILL BE SET TO SINGLE (S).



NOTE: SOS5A -

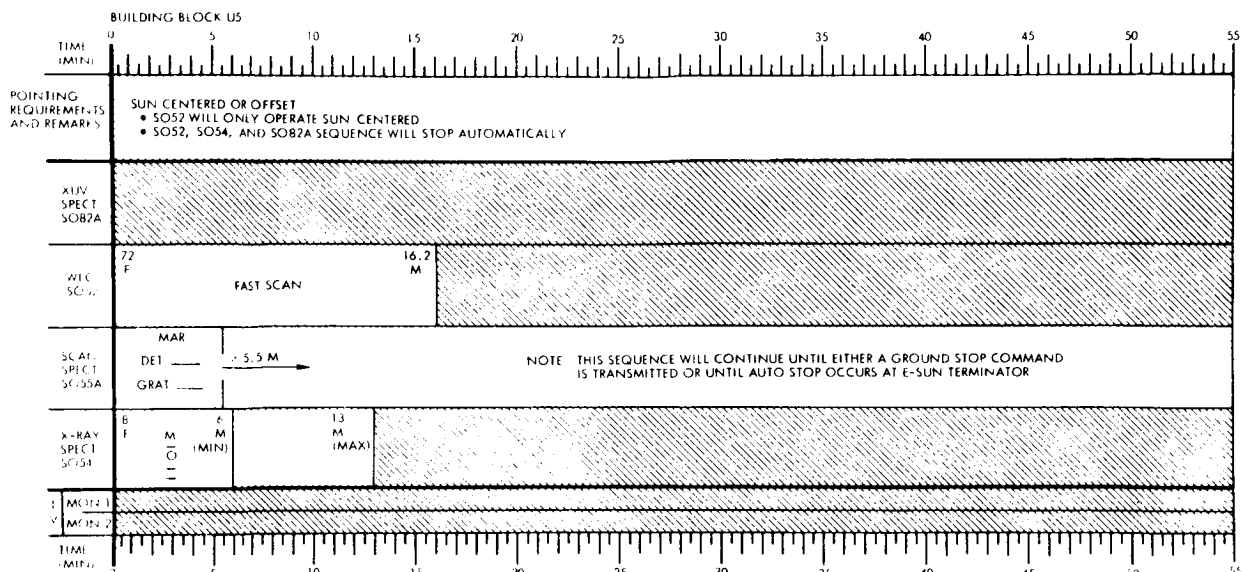
- VERIFY THAT DETECTORS 2-7 ARE OFF.
- GRATING SELECT MUST BE PERFORMED OVER GROUND STATION WHERE TM IS AVAILABLE TO VERIFY DESIRED GRATING SETTING IS REACHED.

- SOS4 -
- ANY FILTER POSITION MAY BE SELECTED, BUT ONLY FILTER NUMBER 1, 2, OR 3 MAY BE GROUND COMMANDED. FILTER NUMBER SELECTED WILL BE INCLUDED ON CREW PAD FOR C4D UNATTENDED OPERATIONS SET-UP.
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NOTE: SOS5A -

- DETECTOR NUMBER WILL BE SELECTED DURING DETAIL PLANNING PERIOD EACH MISSION DAY AND COMMANDED FROM THE GROUND.
 - MODE SWITCH MUST BE SET IN MLS DURING CLOSEOUT OF C4D SINCE THERE IS NO COMMAND CAPABILITY FOR MLS
 - MLS WILL AUTO START AT E-SUN TERMINATOR NEXT ORBIT UNLESS INHIBITED OR UNLESS NEW MODE IS SELECTED AND COMMANDED PRIOR TO SUN RISE TERMINATOR.
- SOS4 -
- ANY FILTER POSITION MAY BE SELECTED, BUT ONLY FILTER NUMBER 1, 2, OR 3 MAY BE GROUND COMMANDED. FILTER NUMBER SELECTED WILL BE INCLUDED ON CREW PAD FOR C4D UNATTENDED OPERATIONS SET-UP.
 - EXPOSURE RANGE SWITCH POSITION AND PICTURE RATE SWITCH POSITION WILL BE DEFINED DURING THE DETAIL PLANNING PERIOD EACH MISSION DAY AND WILL BE INCLUDED ON CREW PAD FOR C4D UNATTENDED OPERATIONS SET-UP. FOR UNMANNED OPERATIONS THE EXPOSURE RANGE SWITCH WILL BE SET TO 256 AND THE PICTURE RATE SWITCH WILL BE SET TO SINGLE (S).

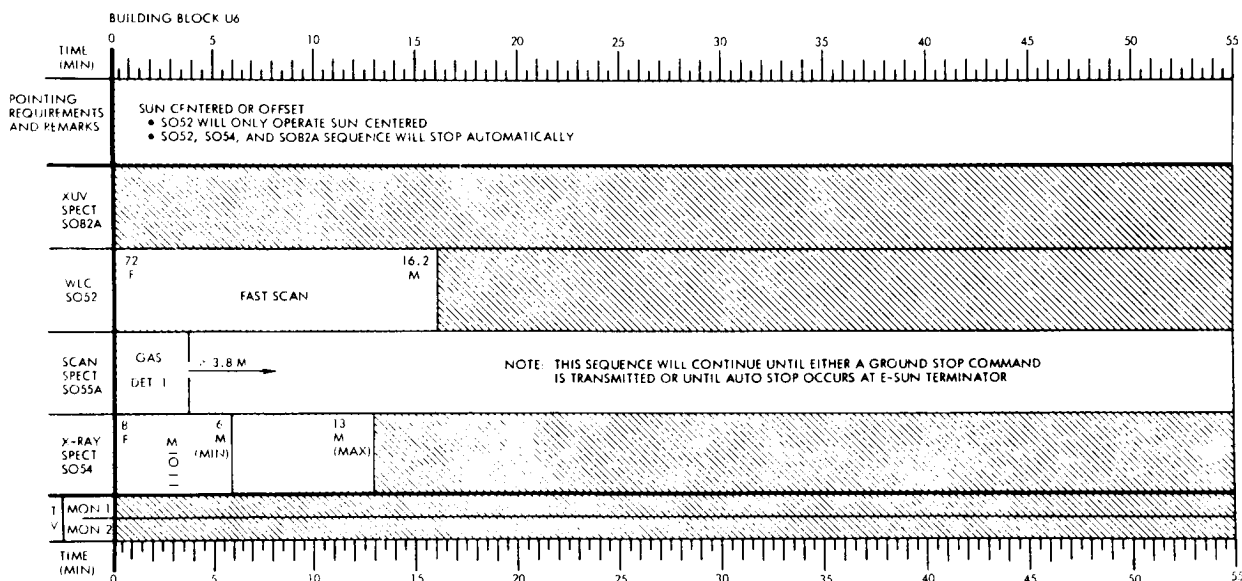


NOTE: SOS5A -

- DETECTOR NUMBER AND GRATING POSITION WILL BE SELECTED DURING DETAIL PLANNING PERIOD EACH MISSION DAY AND COMMANDED FROM THE GROUND.
- WILL AUTO START AT E-SUN TERMINATOR NEXT ORBIT UNLESS INHIBITED OR UNLESS NEW MODE IS SELECTED AND COMMANDED PRIOR TO SUNRISE TERMINATOR.

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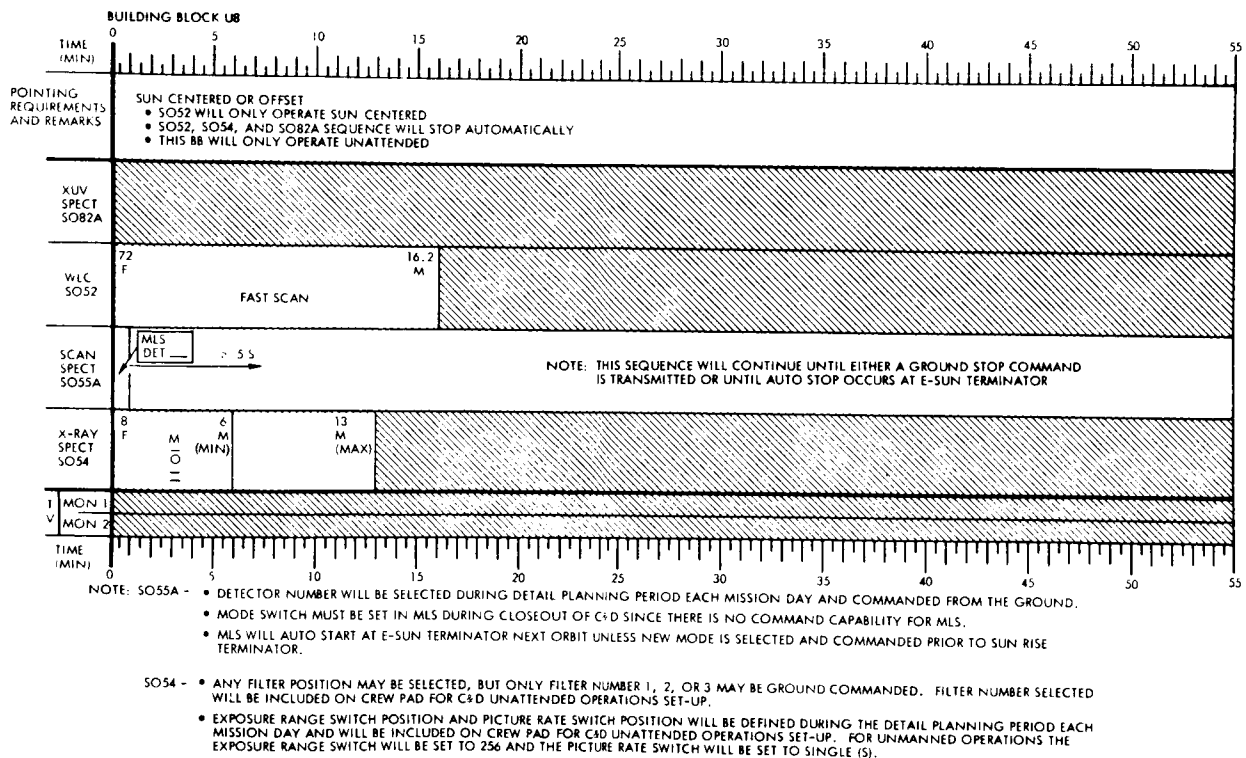
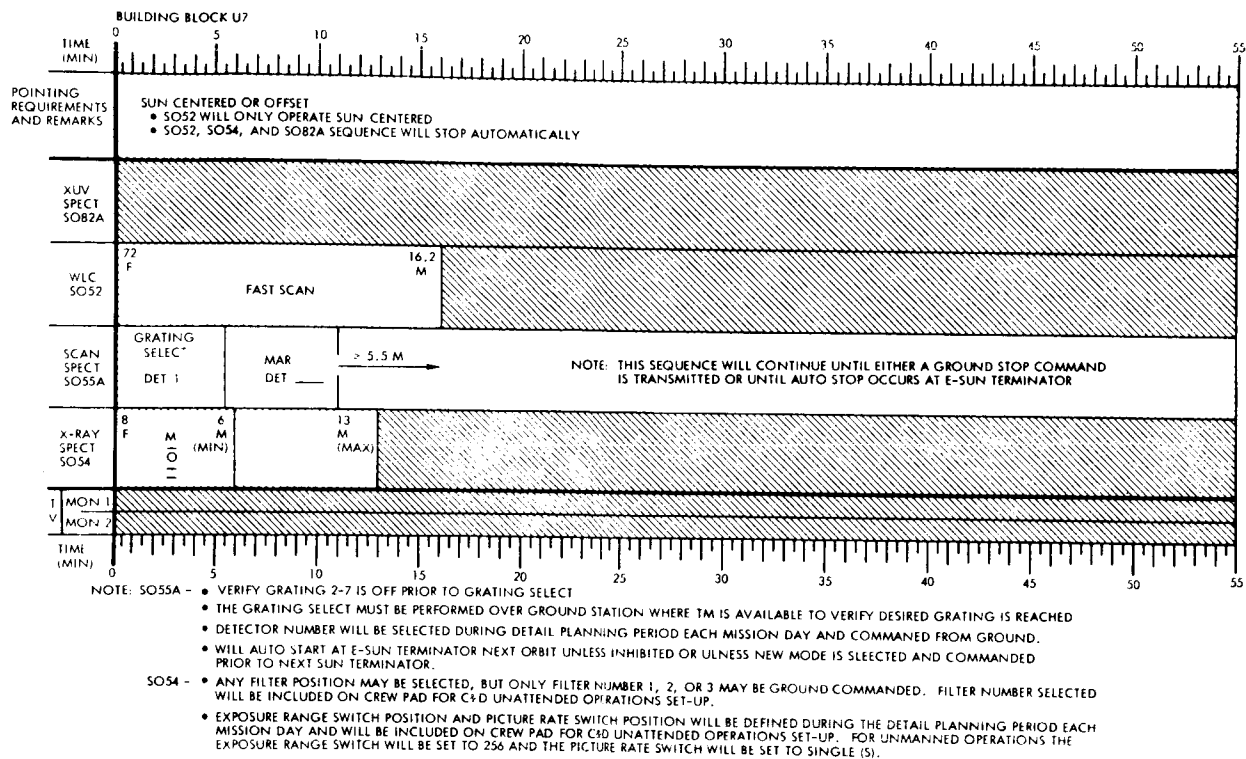


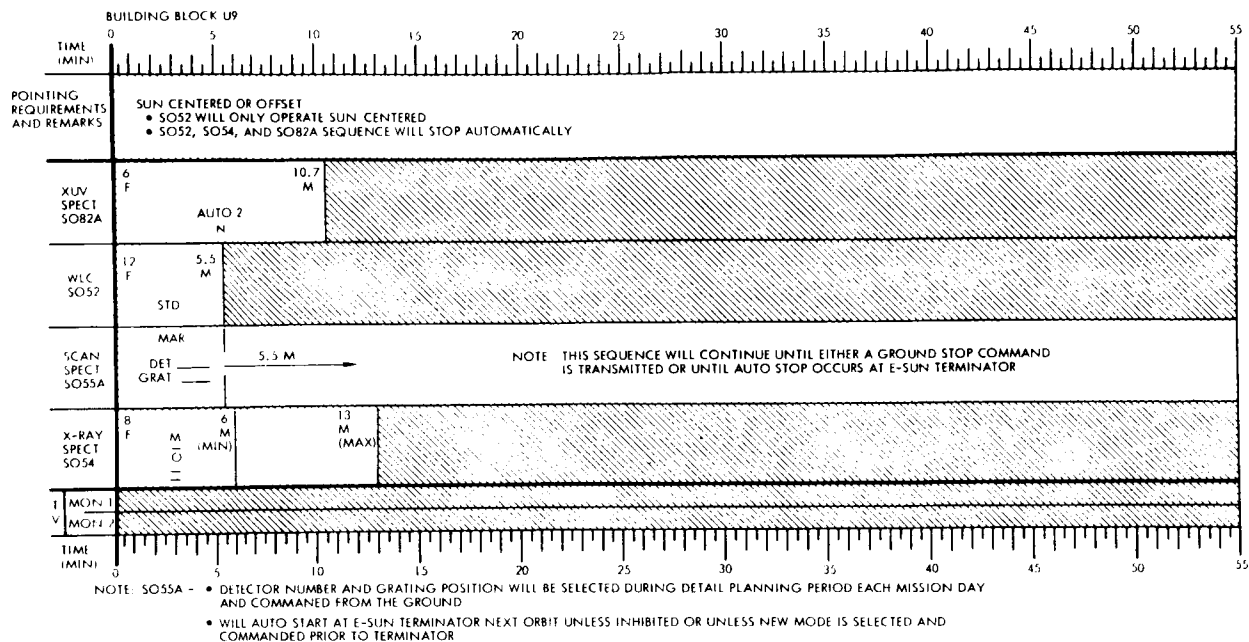
NOTE: SOS5A -

- VERIFY THAT DETECTOR 3-7 IS OFF BEFORE OPERATING.
- WILL AUTO START AT E-SUN TERMINATOR NEXT ORBIT UNLESS INHIBITED OR UNLESS NEW MODE IS SELECTED AND COMMANDED PRIOR TO NEXT SUN RISE TERMINATOR.

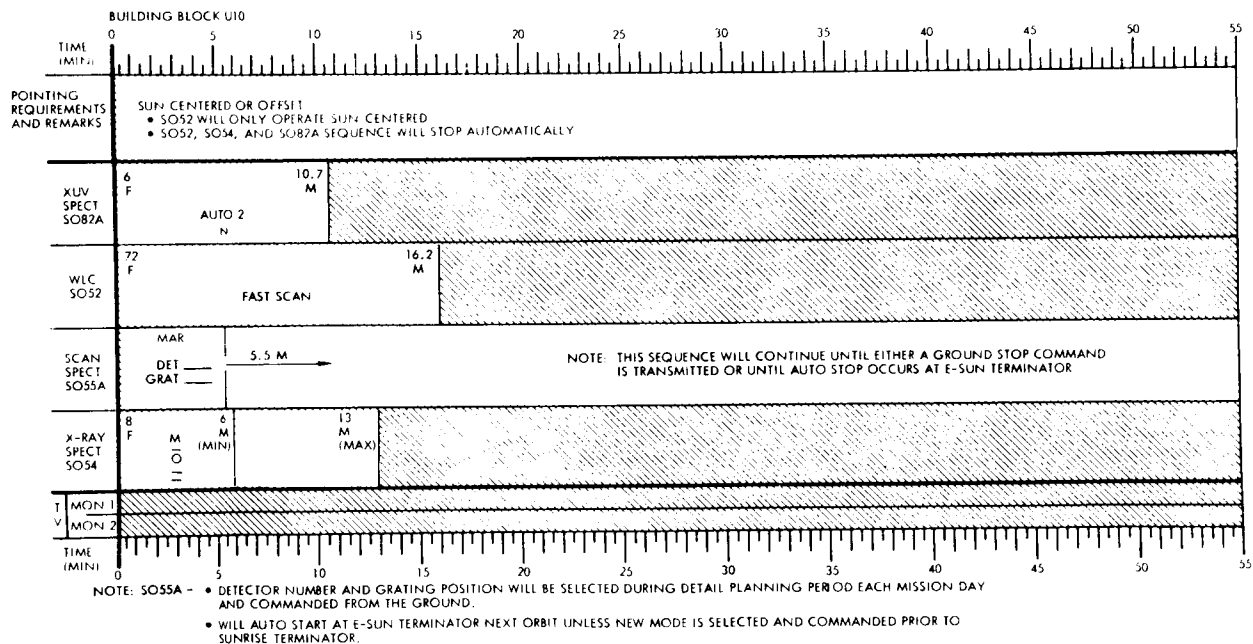
SOS4 -

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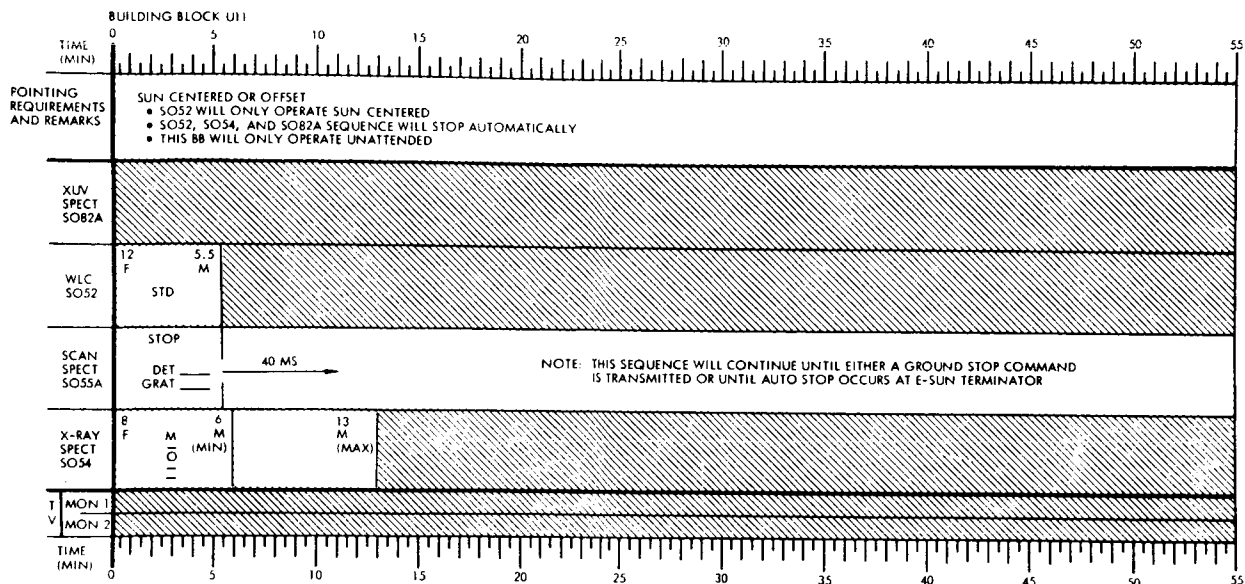




- SO54 -
- ANY FILTER POSITION MAY BE SELECTED, BUT ONLY FILTER NUMBER 1, 2, OR 3 MAY BE GROUND COMMANDED. FILTER NUMBER SELECTED WILL BE INCLUDED ON CREW PAD FOR C4D UNATTENDED OPERATIONS SET-UP.
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- SO54 -
- ANY FILTER POSITION MAY BE SELECTED, BUT ONLY FILTER NUMBER 1, 2, OR 3 MAY BE GROUND COMMANDED. FILTER NUMBER SELECTED WILL BE INCLUDED ON CREW PAD FOR C4D UNATTENDED OPERATIONS SET-UP.
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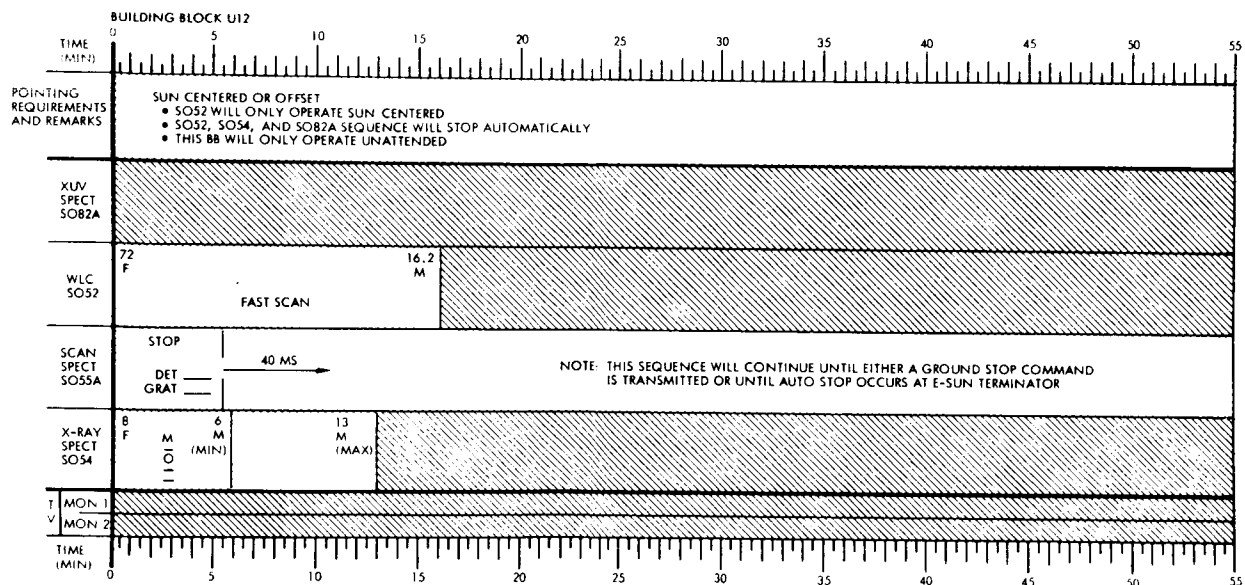


NOTE: SOS5A -

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- WILL AUTO START AT E-SUN TERMINATOR NEXT ORBIT UNLESS INHIBITED OR UNLESS NEW MODE IS SELECTED AND COMMANDED PRIOR TO TERMINATOR.

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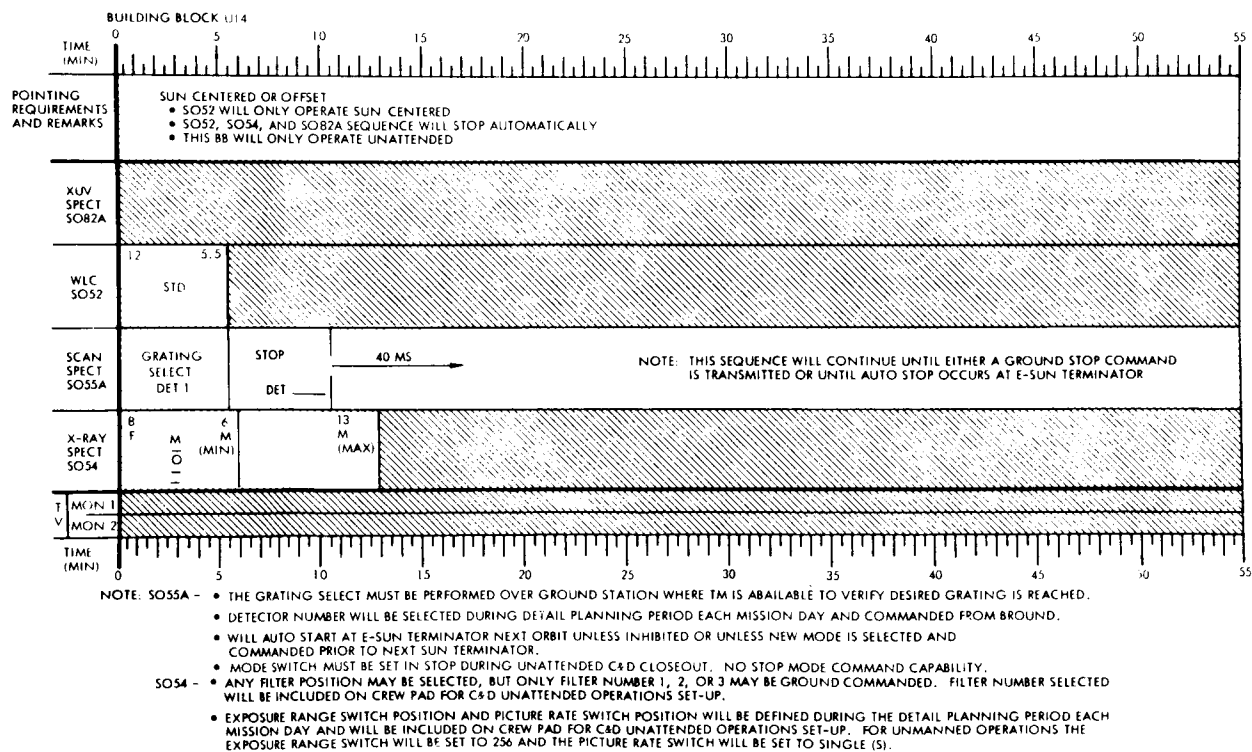
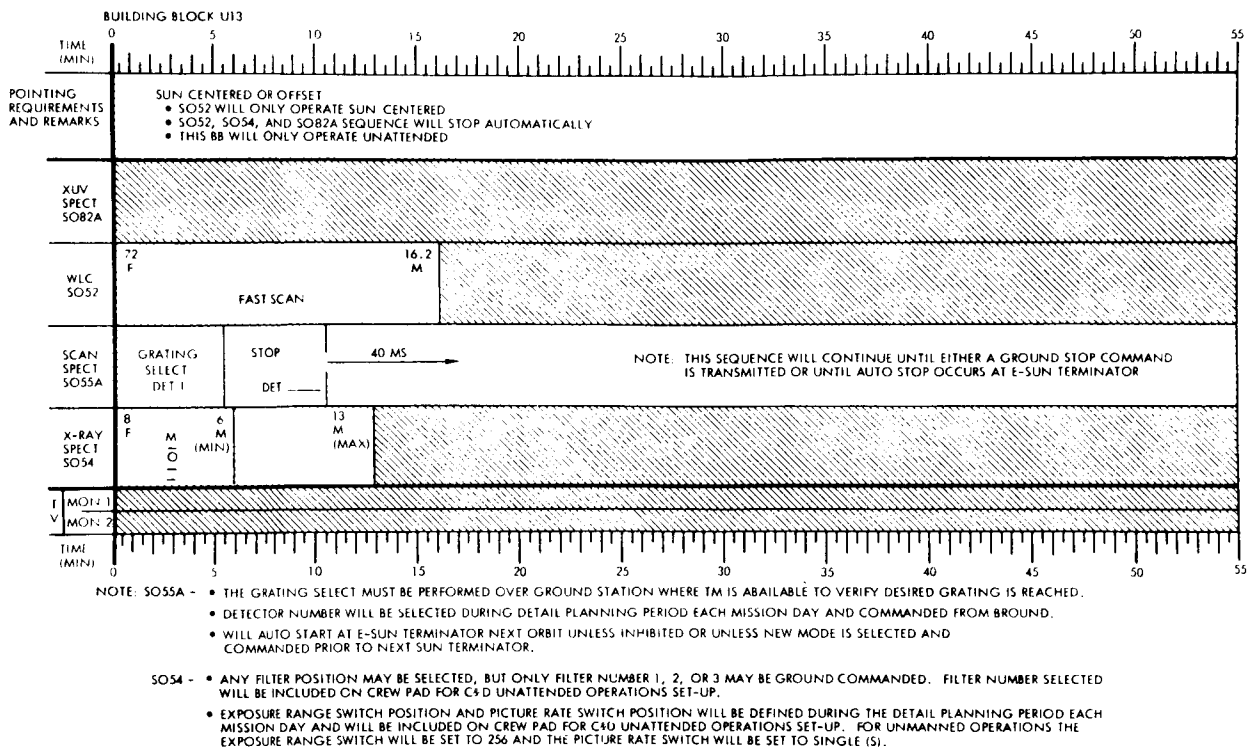


NOTE: SOS5A -

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3.2.3 Earth Resources Experiment Package
Refer to Appendix B.

3.2.4 Corollary Experiments

3.2.4.1 General

The corollary group of experiment DTO's have been designated as those experiment DTO's which are not medical, ATM or EREP experiments, or student investigations.

3.2.4.2 Corollary DTO's

The corollary experiments assigned to the SL-3 mission are:

D024*	Thermal Control Coatings
M487	Habitability/Crew Quarters
M509	Astronaut Maneuvering Equipment
M516	Crew Activities/Maintenance Study
S019	UV Stellar Astronomy
S063	UV Airglow Horizon Photography
S071/ S072	Circadian Rhythm - Pocket Mice/Vinegar Gnats
S149	Particle Collection
S183	UV Panorama
S230	Magnetospheric Particle Composition
T002**	Manual Navigation Sightings (B)
T003	In-Flight Aerosol Analysis
T013*	Crew/Vehicle Disturbances
T020	Foot Controlled Maneuvering Unit
T027/ S073	Contamination Measurement and Gegenschein/Zodiacal Light

The corollary DTO's are presented in alphanumeric order on the following pages.

* Candidate experiment for mission SL-3 - refer to paragraph 2.3.4.1.1(b).

** To be performed at the convenience of the crew and on a non-interference basis with the other experiments.

Obtain thermal radiation data on a variety of coating materials.

Purpose and Background

The purpose is to determine the effects of space environment on selected thermal control coatings and polymeric film, to calibrate earth based laboratory test data, and to gain new insight to the mechanisms of degradation.

Four sample panels, two with 36 disks each of various thermal control coatings and two with 32 strips each of polymeric film, will be returned from space orbit to be analyzed. Two sample panels, one of each type, will be returned by SL-2. The remaining two sample panels may be retrieved on either SL-3 or SL-4 to evaluate the ability of these materials to withstand long duration exposure to a space environment. Measured spectral reflectance, transmittance, physical, and electrical data obtained from samples exposed to the space environment will be compared to earth based laboratory test data.

Functional Objectives

- Determine the effects of long duration (approximately 140 days) exposure to the space environment on selected thermal control coatings and polymeric film.

FO 1) Retrieve two sunlight exposed D024 experiment panels from the Airlock Module (AM) external structure during an Apollo Telescope Mount (ATM) extravehicular activity (EVA).

Performance Requirements

a) Baseline Requirement

FO 1) Two D024 experiment panels, one of each of the two types, will be retrieved during an ATM EVA.

b) Minimum Scheduling Requirement

FO 1) Defer retrieval of the panels until mission SL-4.

c) Performance Redline

FO 1) None

Performance Conditions

FO 1) The D024 sample panels will be exposed to sunlight the maximum amount of time that the flight schedule will allow.

An EVA astronaut will inspect and retrieve two D024 sample panels (one of each type described above) during an ATM EVA in accordance with procedures contained in the appropriate checklist.

* Candidate experiment for this mission - refer to paragraph 2.3.4.1.1(b).

The D024 sample panels will be placed in the material return container which will be sealed during retrieval and checked prior to repressurizing the AM airlock.

The material return container must be provided to the Principal Investigator unopened within four days of recovery. The sample panels must not be exposed to the atmosphere prior to delivery to the Principal Investigator.

In-Flight Data

- a) Telemetry - Time correlated Orbital Assembly position data (accurate to the nearest minute of time and nearest degree of angle) relating three-axis vehicle attitude with respect to sun vector during the duration of D024 specimen exposure to the space environment will be required to support D024 evaluations.
- b) Crew Voice Comments - The EVA crewman retrieving the D024 sample panels will voice record comments regarding disk orientation, the general condition of the samples and panels prior to removal of the panels from the mounting plates, the removal and stowage of the return container, condition of the return container, seal and latches, and verification that the return container is latched and sealed prior to repressurizing the airlock.
- c) Log Books - None
- d) Photographs - Operational 16-mm photographs of the D024 portion of the EVA
- e) Return Payload - Experiment D024 material return container with one panel of 36 thermal control coating disks and one panel of 32 polymeric film strips. (Note: The film in support of D024 is included in the operational film budget as opposed to being part of the D024 return payload.)

For additional details, refer to Appendix A.

Evaluation

Refer to Pre- and Post-Mission Scientific Data Analysis and Reporting Plan for MSFC Skylab Experiments.

Obtain data on Orbital Assembly habitability.

Purpose and Background

The purpose is to gather data on the habitability features of the Orbital Assembly (OA) which will be used in the evaluation of Skylab concepts as they relate to the design of future manned spacecraft.

Skylab habitability provisions will be evaluated by the crew as a function of their everyday living and working interactions with the environment, systems, and equipment in the various OA habitable areas. The habitability evaluations will involve assessments of the following nine elements: environment, architecture, mobility and restraints, food and water, garments and personal accouterments, personal hygiene, house-keeping, communications, and off-duty activities.

Functional Objectives

● Determine the habitability of the OA from crewmen subjective evaluations as a function of in-flight experience.

FO 1) Obtain individual crewman subjective data relative (5% - FO 1)
thru to OA habitability. (10% - FO 2)
FO 3) (15% - FO 3)

FO 4) Obtain group discussion subjective data relative (7.5% each
thru to OA habitability. FO)
FO 7)

● Determine environmental habitability of the OA from instrument measurements.

FO 8) At moments of opportunity, obtain environmental (10%)
measurements as required to support subjective
impressions.

● Determine the habitability of the OA from photographs of selected in-flight activities.

FO 9) Obtain photographs of specific crew activities. (3% each
thru FO)
FO 18)

Performance Requirements

a) Baseline Requirement

FO 1) Data will be acquired by each crewman during early (FO 1), mid
thru (FO 2), and late (FO 3) mission.
FO 3)

FO 4) Group discussion data will be acquired once in each two-week
thru period during the mission.
FO 7)

- F0 8) At moments of opportunity throughout the mission, crewmen at their discretion will record environmental data.
- F0 9) Crew operations will be photographed throughout the mission as shown in the table for Experiment M487 Photographic Requirements.
- F0 18)

b) Minimum Scheduling Requirement

- F0 1) None
- F0 2) None
- F0 3) Same as the baseline requirement
- F0 4) None
- F0 5) Same as the baseline requirement
- F0 6) None
- F0 7) Same as the baseline requirement
- F0 8) None
- F0 9) Same as the baseline requirement
- F0 10) None
- F0 11) Same as the baseline requirement
- F0 12) Same as the baseline requirement
- F0 13) None
- F0 14) Same as the baseline requirement
- F0 15) Same as the baseline requirement
- F0 16) None
- F0 17) Same as the baseline requirement
- F0 18) Any time in the mission

c) Performance Redline

- F0 1) TBD
- thru
- F0 18)

Performance Conditions

- F0 1) At scheduled times and moments of opportunity, the crew will
- thru document habitability features of the OA per procedures contained
- F0 18) in the appropriate checklist.

Time phased periods of data recordings distributed throughout the mission will be required to catalog crewman adaptability as a function of time. Each data recording should include comments on each of the defined areas of interest, covering all aspects including adequacy, utility, comfort, safety, and suggestions for improvement.

Data from each of the FO's are related to establish objective baselines for comparison with the subjective evaluations of the crew for both preflight and in-flight operations.

In those cases where non-nominal situations occur with respect to some element of habitability, real-time assessments will be made by the PI concerning the format and quantity of data desired.

FO 1) The crewmen will use a 3-part subjective evaluation format in
thru the onboard M487 experiment checklist. The individual crewmen
FO 3) will apply unique 5-point subjective evaluations to (but not
limited to) the following:

- a) Work compartments and associated support equipment
- b) Living compartments and associated support equipment
- c) Equipment use frequency

Individual crewman subjective data acquisition periods will be scheduled at convenient and available, but different, times for different crewmen.

The crewmen will voice record Experiment M487 subjective data in the absence of other crewmen.

FO 1) Part 1 of the subjective evaluation format will be used in the early part of the mission.

FO 2) Parts 2 and 3 of the subjective evaluation format will be used in the mid part of the mission.

FO 3) Parts 1, 2, and 3 of the subjective evaluation format will be used in the late part of the mission.

FO 1) Individual crewman and group debriefing data acquisition periods
thru will not be scheduled on the same mission days.
FO 7)

FO 1) Early, mid, and late mission are defined as follows:

- a) Early mission - prior to mission day 14 (inclusive)
- b) Midmission - mission day 28(+7)
- c) Late mission - after mission day 42 (inclusive)

thru
FO 3)
and
FO 9)
thru
FO 18)

FO 4) The crew will use four questionnaire forms (unique for each
thru debriefing) provided in the onboard M487 experiment checklist.

FO 7) All three crewmen will participate in a voice recorded group discussion.

When possible, the experiment debriefings will coincide with operational debriefings.

FO 8) Voice recorded crew discretionary measurements of environmental parameters will support this task.

Measurements of environmental features will be made with Experiment M487 hardware and support equipment which includes sensors/devices for measuring ambient air temperature, dewpoint temperature, surface temperatures, air velocity, sound pressure level and frequency distribution, reflective illumination, locational dimensions, and push/pull force.

Voice recorded readouts and telemetry of onboard OA housekeeping data will support this experiment.

F0 9) Certain repetitive crew operations will be photographed early, thru mid, or late in the mission.

F0 18) Candidate operations for Experiment M487 photography are shown in the following M487 Table of Photographic Requirements.

Voice recorded objective and subjective comments by the crew will be required to support these data.

When possible, the experiment tasks will augment or coincide with operational activities to be observed.

Experiment M487 photography will require 400 feet of 16-mm color film.

Scheduled real-time and video-recorded operational television of onboard activities are desired as a supplement to designated activities to be photographed.

Photographs from other mission operations and experiments are required to support this experiment.

In-Flight Data

- a) Telemetry - Time correlated OWS housekeeping environmental measurements
- b) Crew Voice Comments - Individual and group evaluation comments related to questions and evaluation forms provided, comments related to photographs, readouts of Experiment M487 and supporting measurement hardware, onboard support data, and onboard housekeeping data.
- c) Log Books - As required to support the various Experiment M487 tasks and experiment philosophy
- d) Photographs - One 400-foot cassette of 16-mm film
- e) Return Payload - 16-mm film.

For additional details, refer to Appendix A.

Evaluation

Refer to Pre- and Post-Mission Scientific Data Analysis and Reporting Plan for MSFC Skylab Experiments.

M487
Table of Photographic Requirements

F0	Subject	Mission Time	Frame Rate (fps)	Running Time (Minutes)	Feet Used	Total Feet Used
9	Eating of Meal (Any)	Early	6	5	45	45
10	Eating of Meal (Any)	Mid	6	5	45	90
11	Eating of Meal (Any)	Late	6	5	45	135
12	Cleaning of Mixing Chamber Screens in Dome	Early	2	10	30	165
13	Cleaning of Mixing Chamber Screens in Dome	Mid	2	10	30	195
14	Cleaning of Mixing Chamber Screens in Dome	Late	2	10	30	225
15	Trash Airlock Operation	Early	2	5	15	240
16	Trash Airlock Operation	Mid	2	5	15	255
17	Trash Airlock Operation	Late	2	5	15	270
18	Restocking Pantry	Mid	6	15	130	400

Test and evaluate new maneuvering concepts to enhance future orbital extravehicular activity.

Purpose and Background

The purpose is to demonstrate man's maneuverability while obtaining data and experience on man and Astronaut Maneuvering Unit (AMU) performance in a zero-gravity environment. The data and experience gained will be used to improve analysis techniques and ground based simulators, and to project future AMU design requirements and mission capabilities. The flying characteristics of four different AMU control concepts are provided by an Astronaut Maneuvering Research Vehicle (AMRV) with four operating modes. Crewmen pilots will fly various EVA type maneuvering tasks inside the Orbital Workshop (OWS) to test and evaluate each operating mode described as follows:

- a) Hand Held Maneuvering Unit (HHMU) Mode - This mode will evaluate man's maneuvering capability with a simple, small, lightweight, completely manual, hand-held propulsion device.
- b) Direct Mode.- This mode will be similar to the HHMU in that the astronaut will be completely dependent upon visual cues but differs in that multiple fixed-position thrusters will be used to provide translation and rotation forces about a fixed body axis system through separate (Apollo type) hand controllers.
- c) Rate Gyro Mode - This mode will employ the same thruster configuration and performance characteristics as the direct mode but will have proportional rate command and automatic attitude hold.
- d) Control Moment Gyro (CMG) Mode - This mode will be similar to the rate gyro mode except that attitude control will be provided through momentum exchange instead of mass expulsion. A unique torque balance type CMG will be used which both senses rates and provides actuation moments.

Functional Objectives

● Demonstrate AMU flying qualities and piloting capabilities. Test and evaluate the AMU systems in a zero-g environment.

- | | | |
|-------|--|-------|
| FO 1) | A crewman will perform various familiarization and mission maneuver tests to evaluate all four AMRV operating modes. Total flying time required is 50 minutes. | (15%) |
| FO 2) | The same crewman will repeat some of the familiarization and mission maneuvers (from FO 1) and undertake some exploratory maneuvers to evaluate all four operating modes. Total flying time required is 1 hour 10 minutes. | (25%) |
| FO 3) | The same crewman will repeat many of the previous maneuvering tests (from FO 1 and FO 2) to evaluate all four modes while wearing a pressurized suit. Total flying time required is 1 hour 20 minutes. | (40%) |

- FO 4) The same crewman will repeat some of the mission maneuvers and complete the exploratory maneuvering tests (from FO 1 and FO 2). Total flying time required is one hour. (20%)

Performance Requirements

- a) Baseline Requirement
- FO 1) One crewman will perform the four runs for a total of 4 hours and
thru 20 minutes flight time.
FO 4)
- b) Minimum Scheduling Requirement
- FO 1) Same as the baseline requirement
thru
FO 3)
- FO 4) None
- c) Performance Redline
- FO 1) One crewman will perform an unsuited set of maneuver tests.
- FO 2) None
thru
FO 4)

Performance Conditions

- FO 1) The crewman will wear shirtsleeve-type clothing.
FO 2)
FO 4)
- FO 3) The crewman will wear a pressurized spacesuit with the Astronaut Life Support Assembly (ALSA) and the Life Support Umbilical (LSU). Voice communication will be carried on by the pilot via the LSU. Experiment M509 will have priority over Experiment T020 (Foot Controlled Maneuvering Unit) for the use of the available Secondary Oxygen Pack with the highest pressure.
- FO 1) Four experiment runs will be conducted. Two crewmen will perform the experiment operations, one serving as the test pilot while the other serves as the observer.
- The observer will operate/load the cameras, cue the test pilot on the test procedures, and analyze and describe the test progress via voice communications. The observer will be on voice communication at all times.
- Detailed maneuver elements and times for the four operating modes are contained in the Crew Checklist.
- Nominally, 40 hours will be required between experiment runs to recharge the batteries. The minimum time between runs based on Saturn Workshop (SWS) atmosphere management considerations will depend on run time, gas used, modes used, SWS leakage rate, and crew ECS procedures.

The T027 extension mechanism shall not be installed in the anti-solar SAL during M509 experiment operations. This constraint is due to the proximity of the extension mechanism to the M509 maneuvering volume when installed in the anti-solar SAL.

Intentional OWS maneuvers shall not be performed during experiment operation except for any required ATM CMG gravity gradient momentum dumps.

During experiment operations when in X-IOP/Z, the maximum allowable spacecraft angular rates will be $0.03^\circ/\text{sec}$ about the Y and Z axes and $0.1^\circ/\text{sec}$ about the X axis. When in Z-LV(E), the maximum allowable spacecraft angular rates will be $0.03^\circ/\text{sec}$ about the Z axis and $0.1^\circ/\text{sec}$ about the X and Y axes.

It is highly desirable that the air velocity in the OWS forward compartment not exceed 15 feet per minute during experiment operations.

The start of the first experiment run should be scheduled to maximize real-time monitoring of experiment operations.

The Principal Investigator or his representative will be present at the Mission Control Center - Houston (MCC-H) to assess experiment progress and to consult with the flight control team or crew as required.

In-Flight Data

- a) Telemetry - All M509 telemetry (for FO 1 thru FO 4) and biomedical instrumentation (for FO 3 only) will be recorded on the Airlock Module recorder for subsequent dumping to the ground at scheduled intervals per the Flight Plan.

During each experiment run, some data will be flagged for processing at the MCC-H for postpass performance analysis.

OWS cabin pressure and vehicle rates will be transmitted to the ground during experiment operations for quick-look evaluation.

- b) Crew Voice Comments - Comments made by test pilot and observer during and immediately after each experiment run will be tape recorded and dumped at scheduled intervals per the Flight Plan.
- c) Log Books - Several sheets of the Crew Checklist will have provisions for crew annotation.
- d) Photographs - Complete photographic coverage of all experiment maneuvers will be obtained as part of Experiment M509.

Experiment M151 (Time and Motion Study) will photograph M509 recharging, donning, and doffing operations. Experiment M516 (Crew Activities/Maintenance Study) will photograph M509 launch unstowage and mass handling operations (unless these operations were accomplished during the SL-2 mission).

- e) Return Payload - Five 400-foot cassettes of 16-mm film. (Note: One-half of one of the 400-foot cassettes of 16-mm film will be used by Experiment T020.)

For additional details, refer to Appendix A.

Evaluation

Refer to MSC-03022, Scientific Data Analysis and Reporting Plan.

Obtain data on Skylab man/machine interfaces to validate design criteria.

Purpose and Background

The purpose is to gather data which will allow validation of Skylab man/machine interface criteria in order to establish a data base for future manned spacecraft design. Representative samples of crew activities, including operational tasks, experimental tasks, housekeeping tasks, scheduled and unscheduled maintenance tasks, and a hardware disassembly/reassembly demonstration (SL-4 only) will serve as data sources.

Previous space programs have provided very limited data concerning man's capability to perform physical work in a weightless space environment. Data concerning the crew's ability to use tools and assemble and disassemble equipment (manual dexterity), to maneuver inside the spacecraft (locomotion), and to handle and transfer masses of various sizes (mass handling and transfer) have been limited on previous space flights because of small volume space vehicles and short duration missions. The Skylab Program, which will involve long-term living and working in a zero gravity space environment, will produce considerable data useful to the planners and designers of future manned missions and spacecraft.

Functional Objectives

● Determine man/machine interface criteria from photographs of selected in-flight activities.

FO 1)	Obtain photographs of specific crew activities.	(15% - FO 1
thru		thru FO 6)
FO 7)		(10% - FO 7)

Performance Requirements

a) Baseline Requirement

FO 1)	Certain crew operations will be photographed throughout the
thru	mission as shown in the following M516 Table of Photographic
FO 7)	Requirements.

b) Minimum Scheduling Requirement

FO 1)	Same as the baseline requirement
FO 2)	None
FO 3)	Same as the baseline requirement
FO 4)	None
FO 5)	Same as the baseline requirement
FO 6)	None
FO 7)	Same as the baseline requirement

c) Performance Redline

FO 1)	<u>TBD</u>
thru	
FO 7)	

M516
Table of Photographic Requirements

F0	Subject	Mission Time	Frame Rate (fps)	Running Time (Minutes)	Feet Used	Total Feet Used *
1	Reload Teleprinter Paper	Early	6	5	45	45
2	Reload Teleprinter Paper	Mid	6	5	45	90
3	S183 Unstow, Relocate, Mount	Mid	2	10	30	120
4	S183 Unstow, Relocate, Mount	Late	2	10	30	150
5	M01 Sieve Charcoal Canister Replacement	Mid	6	5	45	195
6	M509 Unstowage from Launch Configuration*	Concurrent with M509	2	23	70	265
7	Remove Film Cassette from S054 Magazine	Mid	6	15	135	400

*See the Performance Conditions section for additional details on the subject to be photographed.

Performance Conditions

- FO 1) At scheduled times and moments of opportunity, the crew will
thru document man/machine interface data per procedures contained in
FO 7) the appropriate checklist.

Voice recorded objective and subjective comments by the crew will be required to support these data.

Candidate mission operations for Experiment M516 photography are shown in the following M516 Table of Photographic Requirements.

Experiment M516 photography will require 400 feet of 16-mm color film.

Scheduled real-time and video-recorded operational television of onboard activities are desired as a supplement to designated activities to be photographed.

Photographs from other mission operations and experiments are required to support this experiment.

- FO 1) Certain crew operations will be photographed early, middle, or
thru late in the mission. These times are defined as follows:
FO 5),
FO 7)

- a) Early mission - prior to mission day 14 (inclusive)
- b) Midmission - mission day 28(+7)
- c) Late mission - after mission day 42 (inclusive)

- FO 6) If Experiment M509 (Astronaut Maneuvering Equipment) unstowage was completed on Mission SL-1/SL-2, the 70 feet of film allocated for FO 6 will be used to photograph selected unscheduled maintenance activities.

If Experiment M509 unstowage was partially completed on Mission SL-1/SL-2, the activities associated with final launch restraint release and backpack repositioning will be photographed using 30 feet of film at two frames per second. The remaining 40 feet of film will be used to photograph selected unscheduled maintenance activities.

Principal Investigator coordination will be required for selection of unscheduled maintenance activities to be photographed.

In-Flight Data

- a) Telemetry - None
- b) Crew Voice Comments - Crew comments for all photographed tasks, and also for any crew discretionary recordings concerning the subjects of manual dexterity, locomotion, and mass handling and transfer

- c) Log Books - As required to support the Experiment M516 tasks and experiment philosophy
- d) Photographs - One 400-foot cassette of 16-mm film
- e) Return Payload - 16-mm film

For additional details, refer to Appendix A.

Evaluation

Refer to MSC-03022, Scientific Data Analysis and Reporting Plan.

Obtain moderate and low dispersion spectra of stellar objects.

Purpose and Background

The purposes are: a) to obtain moderate dispersion stellar spectra ranging from 3000Å to 1400Å with sufficient wavelength resolution to permit the study of ultraviolet (UV) line spectra and of spectral energy distributions of early type stars; and b) to obtain low dispersion UV spectra in a number of Milky Way starfields and in nearby galaxies.

The spectral data will permit detailed physical analysis of the UV radiations of hundreds of individual stars, nebulae, and of the interstellar dust. This large selection of stellar subjects will provide the statistical data for comparison against existing theoretical models. A special emphasis is being placed on a search for previously unsuspected anomalies in the physics of stars and the interstellar dust.

From this spectral data, it will be possible to measure the existence and relative intensity of absorption and emission lines. The spectral information will provide insight into the origin and composition of the stars, emission nebulae, and the interstellar dust. The temperature, pressure, and size of the star's atmosphere will be determined from the spectral data. Changes in temperature and pressure will indicate the nature of the star's energy, or luminosity. These environmental determinations will provide added information on the age, life span, nature of the mass ejection mechanisms, processes of star formation, and evolution of stars.

Functional Objectives

● Obtain moderate dispersion spectra of early type stars and low dispersion spectra of Milky Way starfields and nearby galaxies.

F0 1)	Obtain selective UV photographs of as many designated	(8%
thru	starfields as possible on darkside passes.	each
F0 12)		F0)

Performance Requirements

a) Baseline Requirement

F0 1)	One hundred fifty photographs of selected starfields
thru	are required. Twelve photographic periods (F0 1 thru F0 12)
F0 12)	will be scheduled during night side passes of 32 minutes
	average duration. Photographic periods of less than 32
	minutes duration are acceptable, provided the lost time is
	made up during other nightside passes of greater than 32
	minutes duration or by scheduling photographic periods during
	additional nightside passes.

b) Minimum Scheduling Requirement

F0 1)	Eight photographic periods (F0 1 thru F0 8) during night side
thru	passes of 32 minutes average duration are required.
F0 12)	

c) Performance Redline

- FO 1) Continue to schedule toward the minimum scheduling requirement.
thru
FO 12)

Performance Conditions

- FO 1) The potential starfields to be photographed will be updated by
thru computer based upon exact orbital conditions of the Orbital
FO 12) Workshop (OWS). The updated starfields and pointing coordinates
(mirror tilt and rotation angles, etc.) will be supplied to the
crew 24 hours prior to the experiment session.

To maximize the scientific return of this experiment, it is highly desirable that within the constraint of the 150 exposures, the astronaut be allowed as much flexibility in his choice of starfields and exposure times as possible. It is highly desirable to have two separate observing periods with an interval of at least five days.

The spectrograph (consisting of a film canister, optical canister, and mirror system) will be assembled into a unit and mounted in the anti-solar Scientific Airlock (SAL) and the mirror oriented toward the target starfield per procedures contained in the appropriate checklist.

The duration of any given exposure will be within 10 percent of its programmed duration.

Programmed exposure times are 30, 90, and 270 seconds. The starfield brightness will determine which combinations of exposure times are used. In some cases only two exposures may be required, in other cases three may be required, and when the stability of the OWS permits (i.e., where the OWS has a rate of 1/2 arc second/second or less and the direction is within 45 degrees of the direction of dispersion) a fourth exposure without the use of the spectral widening mechanism may be desirable.

Pre-exposure attitude knowledge of the Orbital Assembly (OA) to within 2.5 degrees (in the stellar inertial reference system) will be required in order to allow the operator to locate designated target starfields.

To acquire high priority starfields in the field-of-view (FOV) it may be necessary to roll the OA up to ± 10 degrees about the X-axis. This maneuver will be performed one time only during a night side pass of at least 32 minutes, when there is a crewman at the ATM console and when it causes no interference with other experiments. This 10-degree roll maneuver and any roll maneuver allocated to any other DTO using the S019 hardware will not be conducted on consecutive passes.

The experiment should be performed when the moon is less than half illuminated and when the OA is in an inertially stable mode, e.g., Solar Inertial Attitude (X-IOP/Z).

The mirror should be extended just before sunset and retracted just after sunrise.

To minimize exposure time to radiation, the film canister must be demounted and stowed in the film vault between observing periods separated by more than 12 hours. It is permissible to have the remainder of the experiment in the airlock during this period if the cover is placed on the optical canister and the assembly is vented to space. A total exposure duration to the ambient radiation environment that will exist when out of the film vault shall not exceed 96 hours for the film canister.

If it is necessary to remove the experiment from the airlock, all experiment equipment (mirror system, optical canister, and film canister) must be evacuated to 1 torr or less. Evacuation is to begin as soon as possible after experiment disassembly and in no case should the time to begin evacuation exceed 30 minutes.

The UV optical components in the interior of the experiment hardware will be protected by storing in an evacuated condition. Exposure to cabin atmosphere should be limited to a short time interval during installation into the SAL and again at removal.

Ambient temperature conditions are tolerable for the duration of experiment operation periods.

The film canister stowed in its Flight Stowage Container will be transferred to the Command Module prior to SL-3 separation at such a time as to be compatible with the constraint that the film canister shall not be out of the OWS film vault for more than a cumulative total of 96 hours from initial removal of the film from the film vault to the time of spacecraft separation. All other experiment hardware will remain stowed as for launch.

Experiment M509 (Astronaut Maneuvering Equipment), T020 (Foot Controlled Maneuvering Unit), and T013 (Crew/Vehicle Disturbances) must not be operated while S019 equipment is installed in the SAL.

During experiment operation the following lighting conditions will be required:

- a) All OWS interior lights with the exception of those listed in the appropriate checklist must be turned off five minutes before the beginning of the experiment operation period and remain off throughout the entire period. All ports or windows from any remaining lighted portion of the OA will be covered to prevent light ($\lambda < 5000\text{\AA}$) from scattering into the spectrograph.
- b) Onboard pen lights, with red filters designed for use during S019 operation, are acceptable without restriction.
- c) All exterior vehicle running lights will be turned off.

Thruster Attitude Control Subsystem (TACS) firings will be minimized when the mirror system is extended. There will be no Service Module Reaction Control Subsystem firings when the mirror system is extended.

Moisture must not be allowed to condense on the S019 mirror system.

Venting from the following controllable external OA vents will be completed 30 minutes prior to and avoided during the performance of experiment photographic sequences:

- a) SWS blowdown or cabin atmosphere vent
- b) AM EVA vent
- c) CSM RCS
- d) AM condensate system vent (contingency)
- e) CSM vents from steam duct, urine dump, and waste water dump

External OA venting from the following operations will be completed 15 minutes prior to and avoided during the performance of experiment photographic sequences:

- a) M092
- b) M171

The quality of the spectra (i.e., the wavelength resolution) produced by this experiment depend critically on the spacecraft rates and spacecraft stabilization. Uniform rates (i.e., relatively constant over a period of 1 minute) are acceptable and of no concern up to magnitudes of 1 arc sec/sec. Rates between 1 and 10 arc sec/sec are acceptable; uniform rates in excess of 10 arc sec/sec are unacceptable.

High frequency (approximately 1 hertz and greater) deviations (harmonic oscillations or random noise) are acceptable so long as the 1 sigma amplitude of angular displacement does not exceed 20 arc seconds.

Excursions resulting from random transitory events, such as crew motion are acceptable without limitation or magnitude so long as the interval between such events exceed 2 minutes. More frequent excursions of this nature are acceptable only if the 1 sigma amplitude of the excursion is 20 arc seconds or less.

Crew motions are to be kept to a minimum during S019 exposures. Scheduling of crew activities which may cause spacecraft movement (e.g., transfer of heavy equipment, exercises which require the crew to push off from the spacecraft walls, etc.) are to be avoided during S019 operation periods.

It will be necessary to inhibit momentum dump maneuvers during the period when this experiment is operating since this experiment cannot operate while the spacecraft is in motion.

In-Flight Data

- a) Telemetry - None
- b) Crew Voice Comments - The following will require voice comments:
 - 1) The exposure number
 - 2) Target field identification
 - 3) Time of initiation correlatable to Greenwich Mean Time (GMT) to within 1 minute
 - 4) Length of exposure
 - 5) Comments on the quality of image tracking conditions and any other noteworthy conditions relative to the experiment
- c) Log Books - None
- d) Photographs - One hundred and fifty photographs of selected starfields
- e) Return Payload - S019 Film Canister containing 164 slides (150 of which have been exposed)

For additional details, refer to Appendix A.

Evaluation

Refer to MSC-03022, Scientific Data Analysis and Reporting Plan.

Purpose and Background

The purpose is to photograph in visible and ultraviolet light the earth's ozone layer. (Note: The airglow photography portion of this experiment has been deleted.)

Ozone exists in the atmosphere in a broad layer between 15 km and 50 km with a maximum concentration in the vicinity of 25 km. The distribution of ozone varies with geographic location, the seasons, and diurnally. By recording the ozone distribution around the world using UV photography, this experiment will provide a new approach for answering questions about the ozonosphere. These questions relate to the circulation of the ozone, its connection with the morphology of weather patterns, and its role in the production of hydroxyl emission in the airglow. Photographs over areas traversed by high-flying jet-engined aircraft may contribute to analysis of engine exhaust pollution problem.

Functional Objectives

- Obtain data on the earth's ozone layer.

FO 1)	Obtain selective UV photographs of the earth's ozone	(17%
thru	layer and simultaneous visible photographs of terrain	each
FO 6)	and cloud features beneath the ozone layer during	FO)
	Z-LV passes.	

Performance Requirements

a) Baseline Requirement

FO 1)	Seventy-six UV photographs of the earth's ozone layer and 61
thru	simultaneously acquired visible photographs of terrain and cloud
FO 6)	features beneath the ozone layer are required. Six photographic
	periods (FO 1 thru FO 6) will be scheduled during Z-LV passes of
	26 minutes average duration. Photographic periods of less than
	26 minutes duration are acceptable, provided the lost time is
	made up by scheduling photographic periods during additional Z-LV
	passes.

b) Minimum Scheduling Requirement

FO 1)	Ultraviolet photographs of the earth's ozone layer and simulta-
thru	neously acquired visible photographs of terrain and cloud features
FO 6)	beneath the ozone layer are required to be taken on four (FO 1
	thru FO 4) Z-LV passes of 26 minutes average duration each.

c) Performance Redline

FO 1)	Continue to schedule toward the minimum scheduling requirement.
thru	
FO 6)	

Performance Conditions

FO 1)	Experiment Assembly I (EA-I) (consisting in part of two cameras,
thru	one for taking UV photographs and the other for taking regular
FO 6)	color photographs) will be used. The UV camera will be mounted

at the anti-solar Scientific Airlock (SAL). The color camera will be mounted in the wardroom window of the Orbital Workshop (OWS) and will automatically take photographs simultaneously with the UV camera.

Photographs of the ozone layer, which is approximately 30 km above the earth's surface and not visible, will be accomplished while visually tracking an earth geographical feature with the optical sight. The camera is coupled to the visual tracker in such a manner that it will photograph the 30 km level above the earth.

Photographs will be made:

- a) Over the United States to provide values for comparison with ground based observations
- b) Over a variety of terrain, e.g., sea, desert, green forests or fields, cities, snow, cloud layers, etc., to provide a check on the efficiency of the three-color filter principle
- c) Over the entire globe at different seasons and different latitudes to view the ozone concentration as distributed over the earth, especially in areas where no ground stations are available.

It is highly desirable to obtain photographs of any violent weather disturbance, such as a hurricane, and the contrail of a high altitude multi-engine jet aircraft such as one being used by EREP for under-flight or military aircraft.

The optical sighting device will be kept pointed to within 0.5 degrees on a chosen tracking feature.

Image Motion Control (IMC) will be maintained manually by the experimenter through the duration of the exposure. Required tracking rates are functions of orbital position and target altitude. Approximate average rates are 1 degree/sec.

The 76 UV photographs will be obtained according to the following schedule:

<u>Quantity</u> ⁽¹⁾	<u>Sun Angle</u> <u>(degrees)</u>	<u>Nominal Exposure</u> ⁽⁴⁾ <u>Time (sec)</u>	<u>Filter</u> <u>(Angstroms)</u>
8 ⁽²⁾	60 to 40	16	2800
8 ⁽²⁾	60 to 40	16	3200
15 ⁽²⁾	40 to 15	8	2800
15 ⁽²⁾	40 to 15	8	3200
15 ⁽³⁾	15 to 0	2	2800
15 ⁽³⁾	15 to 0	2	3200

The 61 color exposures (one taken simultaneously with each UV exposure) will have a duration of 1/250 second. (See Note 3)

NOTE: See notes at end of this DTO.

- FO 1) Detailed photographic operations will be conducted in accordance with procedures contained in the appropriate checklist.
- FO 6) The maximum pitch, yaw, or roll rates during the exposure period will not exceed 0.1 degree/sec.

Venting from the following controllable external vents will be completed 15 minutes prior to and avoided during the performance of experiment photographic sequences:

- a) SWS blowdown or cabin atmosphere vent
- b) AM EVA vent
- c) CSM RCS
- d) AM condensate system vent (contingency)
- e) CSM vents from steam duct, urine dump, and waste water dump

Experiment M509 (Astronaut Maneuvering Equipment), T020 (Foot Controlled Maneuvering Unit), and T013 (Crew/Vehicle Disturbances) must not be operated while S063 equipment is installed in the SAL.

The film and cameras (if loaded with film) will be protected from radiation by stowing in drawer J of the OWS film vault when experiment operation times are separated by more than four hours and when the spacecraft is in that portion of the South Atlantic Anomaly where the accumulated projected radiation levels could damage the film.

Voice tapes of astronaut annotations during experiment operations are to be dumped after each photographic session.

In-Flight Data

- a) Telemetry - None
- b) Crew Voice Comments - Voice annotation by the astronaut will be made for each exposure taken and will include camera identification, filter code, series, camera orientation, exposure initiation in Greenwich Mean Time (GMT) within 1.0 second, exposure number, and exposure duration.

Prior to each photography session a voice recording of beginning exposure number, filter identification, initial camera bracket setting, GMT, and identification of any targets of opportunity will be made.

Voice annotation by the astronaut will be made at the end of each session and will include orbit number, location of experiment (i.e., ground track), latest exposure number, and condition of equipment at end of last session.

- c) Log Books - None
- d) Photographs - Seventy-six photographs of the earth's ozone layer and 61 visible photographs of terrain and cloud features beneath the ozone layer are required.

- e) Return Payload - Two cassettes of 35-mm black and white film, and two cassettes of 35-mm color film

For additional details, refer to Appendix A.

Evaluation

Refer to JSC-03022, Scientific Data Analysis and Reporting Plan.

NOTES:

- 1) Orbital circumstances may not permit scheduling to obtain the desired number of exposures for each group of sun angles listed. While the best pictures will be made with the angle between the sun and the local vertical at a minimum, the experiment objectives can be met with longer exposures and larger angles provided that at least five sets (10 exposures five through each of the two UV filters) are made for sun angles between 0° and 15° .
- 2) After each exposure, the camera/sight carriage must be reset to the start position. Exposures will be made alternately through the two UV filters.
- 3) These exposures will be made in pairs. On a given target, two exposures should be made in rapid succession, one through each UV filter. Only one color exposure will be made for each pair of short exposures.
- 4) Actual exposure times will be supplied to the crew prior to the experiment session.

Obtain circadian rhythm data on pocket mice and vinegar gnats.

Purpose and Background

The purpose is to determine the persistence of the circadian rhythms of body temperature and activity in pocket mice. Additionally, the purpose is to determine the persistence of circadian rhythms in the vinegar gnat.

A statistical analysis of all data (ground and flight) acquired will be performed to determine any variance between the circadian rhythms observed in the flight group while in orbit with respect to the circadian control groups. The analysis will be performed by the experimenter at his facilities using computer methods developed for this purpose. A significant digression of either the precision or lengths of the "free running" circadian periods measured in space from those periods measured on earth would constitute evidence of dependency of circadian organization upon geophysical "cues". Conversely, continuance in space of the precise "free running" circadian periods measured on the ground would significantly reduce arguments in favor of dependency of circadian organization upon geophysical "cues".

Functional Objectives

Determine the persistence of circadian rhythms in pocket mice and vinegar gnats.

- FO 1) Obtain data to determine the persistence of circadian rhythms in pocket mice. (50%)
- FO 2) Obtain data to determine the persistence of circadian rhythms in vinegar gnats. (50%)

Performance Requirements

a) Baseline Requirement

- FO 1) No crew operations are required except for removing power from the experiment upon completion of each experiment. The only other operations would be as a backup to ground commands. All experiment operations will be nominally controlled from the ground.
- FO 2) After a minimum of 28 days in orbit, the S071 power switch will be placed in the OFF position.
- FO 1) After approximately 20 days of operation, the S072 power switch will be placed in the OFF position.

b) Minimum Scheduling Requirement

- FO 1) Continue to schedule toward the baseline requirement.
- FO 2)

c) Performance Redline

- FO 1) Continue to schedule toward the baseline requirement.
- FO 2)

Performance Conditions

- FO 1) Six pocket mice, in individual cages that provide living space and food for each mouse, will be placed in orbit in an internal environmental control system that provides a constant atmosphere to the mice.
 Mice cage temperature will be held constant within 0.5°C in a temperature range of 20(+2)°C.
 The cage pressure will be held constant within ±2% in a pressure range of 700(+60) mm Hg.
 The air composition will be maintained at a near normal atmosphere.
 The circadian rhythms of each mouse will be continuously monitored from launch for a minimum period of 28 days.
- FO 2) The mounting plate temperature in the pupae compartment will be maintained at a temperature of 5(+0.5)°C until the "Vinegar Gnat Initiate" ground command is issued.
 After orbital insertion, a "Vinegar Gnat Initiate" ground command will be issued to commence a sequence of events that start the development of vinegar gnat pupae in four separate units, each housing 180 pupae.
 The plate temperature in the pupae housing units will be raised to approximately 20°C(+0.5°C).
 After the temperature has stabilized (within 70 minutes) the pupae in each of the four compartments will be exposed (two compartments at a time) to a stimulus light. Confirmation of stimulus light operation will be required.
 The date and time of day of the initiate command, of the 20°C temperature stabilization, and of the first stimulus light operations within ±5 minutes will be recorded on the ground.
- FO 1) The S072 control electronics will monitor the ambient temperature for the pupae of each housing unit and relay these data to the S071 Circadian Data System (CDS) every 10 minutes to be stored in memory. (Each 10-minute data frame consists of both S071 and S072 instrumentation.)
- FO 2) The stored S072 data will be relayed to the ground receiving stations together with the S071 data upon ground command.
 Data dumps will be scheduled at convenient intervals not to exceed 19 hours during the operation of S071 and S072.

In-Flight Data

- a) Telemetry - Experiment measurements will be recorded for subsequent playback and transmission to the ground.
- b) Crew Voice Comments - None
- c) Log Books - None
- d) Photographs - None
- e) Return Payload - None

For additional details, refer to Appendix A.

Evaluation

Refer to Pre- and Post-Mission Scientific and Data Analysis and Reporting Plan for MSFC Skylab Experiments.

Determine distribution, composition, and morphology of micrometeorites in near-earth space.

Purpose and Background

The purposes are to determine the mass distribution of micrometeorites in near-earth space by studying the impact phenomena that are produced on suitably prepared and exposed surfaces and to determine the composition and morphology of micrometeorites from an examination of micrometeorite deposits in the impact craters.

Micrometeorite impact data shall be acquired through the use of two types of impact surface detectors. The largest portion of the impact surface detection area consists of highly polished surfaces that have been pre-scanned with optical microscopes. The remaining area consists of thin film. The principle of the multiple film detector system is to allow examination of the layered film as a unit to facilitate identification of film penetration events. The coincidence of holes in the layered film plus the characteristics of the impact event on the underlying witness plate will determine cosmic origin.

Functional Objectives

● Determine the mass distribution of micrometeorites in near-earth space.

- FO 1) Deploy and expose during the unmanned phase of SL-3 one set (4) of Micrometeorite Impact Detection Cassettes. (40%)
(The cassettes will be prepared for deployment and exposure during SL-2, and will be retrieved and returned to earth during the manned phase of SL-3.)
- FO 2) Deploy and expose one set (4) of Micrometeorite Impact Detection Cassettes during the manned phase of SL-3. (25%)
(The cassettes will be retrieved and returned to earth during the manned phase of SL-3.)
- FO 3) Prepare one set (4) of Micrometeorite Impact Detection Cassettes for deployment and exposure during the unmanned phase of SL-4. (35%)
(The cassettes will be retrieved and returned to earth during the manned phase of SL-4.)

Performance Requirements

- a) Baseline Requirement
 - FO 1) Exposure of the Micrometeorite Impact Detection Cassettes during the unmanned phase of SL-3 is required. Retrieval and stowage of four detection cassettes for return to earth during the manned phase of SL-3 is required.
 - FO 2) Exposure of one set (4) of Micrometeorite Impact Detection Cassettes for 240 hours during the manned portion of SL-3 is required. Retrieval and stowage of four detection cassettes for return to earth during the manned phase of SL-3 is required.

F0 3) Preparation of one set (4) of Micrometeorite Impact Detection Cassettes for exposure during the unmanned phase of SL-4 is required.

b) Minimum Scheduling Requirement

F0 1) Exposure of the Micrometeorite Impact Detection Cassettes during 75 percent of the unmanned phase of SL-3 is required. Retrieval and stowage of four detection cassettes for return to earth during the manned phase of SL-3 is required.

F0 2) Exposure of one set (4) of Micrometeorite Impact Detection Cassettes for eight hours during the manned portion of SL-3 is required. Retrieval and stowage of four detection cassettes for return to earth during the manned phase of SL-3 is required.

F0 3) Same as the baseline requirement

c) Performance Redline

F0 1) Continue to schedule toward the minimum scheduling requirement.
thru
F0 3)

Performance Conditions

F0 1) Ground control will open the cassettes for exposure during the unmanned phase of SL-3 approximately six hours after the separation of the SL-2 CSM from the Orbital Workshop (OWS).

With the exception of any ground commanded or other foreknown venting, the cassettes will remain open throughout the unmanned phase.

Ground control will close the cassettes approximately six hours before docking of the SL-3 CSM to the OWS for the manned phase of SL-3.

The Motor Drive/Cassette Support Unit (MDCSU) containing the four detection cassettes will be retrieved and stowed according to procedures contained in the appropriate checklist.

F0 2) The MDCSU containing four detection cassettes will be deployed from the anti-solar SAL according to procedures contained in the appropriate checklist.

The impact surfaces must be protected from contamination during an exposure period. This will be accomplished per procedures contained in the appropriate checklist by closing the detector cassettes during periods when contaminants could be deposited on the surfaces.

Experiments M509 (Astronaut Maneuvering Equipment), and T020 (Foot Controlled Maneuvering Unit) must not be operated while S149 equipment is installed in the SAL.

The MDCSU containing the four detection cassettes will be retrieved and stowed according to procedures contained in the appropriate checklist.

- FO 3) The MDCSU containing four detection cassettes will be deployed from the anti-solar SAL just prior to SL-3 CSM separation per procedures contained in the appropriate checklist.
- Ground control will cycle the detection cassettes just prior to crew departure to insure proper operation. In the event that ground control cannot open the cassettes, they are to be opened by a crewman as near to CSM separation as possible.

- FO 1) The detection cassettes must be closed during and remain closed thru for 15 minutes after completion of the following events (as FO 3) applicable):

- a) Contingency condensate dump
- b) All unbagged water dumps into the OWS waste tank
- c) AM airlock depressurization for EVA
- d) Venting for Experiment M092 (In-Flight Lower Body Negative Pressure) or M171 (Metabolic Activity)
- e) CSM RCS firings
- f) CSM vent from steam duct, urine dump, and waste water dump

The detection cassettes must be closed during and remain closed for 12 hours after completion of a SWS blowdown or cabin total atmosphere vent.

In-Flight Data

- a) Telemetry - Experiment and spacecraft housekeeping measurements will be recorded for subsequent playback and transmission to the ground. Telemetry data are to include vehicle attitude deviations from the nominal solar inertial mode whenever the vehicle attitude varies more than 15 degrees about any axis from the nominal attitude.
- b) Crew Voice Comments - Voice comments will be required concerning experiment preparation, checkout, operation, and postoperation tasks.
- c) Log Books - None
- d) Photographs - None
- e) Return Payload - One set of four cassettes exposed during the unmanned portion of SL-3 and one set of four cassettes exposed during the manned portion of SL-3.

For additional details, refer to Appendix A.

Evaluation

Refer to MSC-03022, Scientific Data Analysis and Reporting Plan.

Experiment S150

GALACTIC X-RAY MAPPING (B)

Survey portion of the sky for x-rays.

Purpose and Background

The purposes are to survey a portion of the celestial sphere for X-rays in the 200 to 12,000 electron volt range and determine the intensity, location, and spectrum of each X-ray source. The experiment will determine if there is a continuous background of X-rays, or discrete sources. The results of the experiment will help answer questions concerning emission mechanism in X-ray sources, the distance to the sources, and the nature of the interstellar medium.

Proportional counters and pulse height analyzers are flown on the Instrument Unit of the launch vehicle (IU-SIVB). After Command and Service Module separation the IU/SIVB maneuvers, as it orbits the earth, to allow the instruments to scan about half the sky. The data from the pulse height analyzers are recorded on magnetic tape and dumped once each orbit. Star sensors help determine the pointing direction of the proportional counters.

Functional Objectives

- Obtain data on X-rays in the 200 to 12,000 electron volt range over a portion of the celestial sphere.

F0 1) Expose the Experiment Sensor located in the IV-SIVB to space
thru after separation of the CSM from the SIVB.
F0 5)

(Note: The S150 experiment operation will not require flight crew involvement; however, it will require participation of Mission Control Center-Houston personnel for transmission of ground commands.)

Performance Requirements

a) Baseline Requirement

F0 1) The IU/SIVB will be maneuvered to a specified attitude at the
thru beginning of five consecutive orbits (F0 1 thru F0 5) to scan
F0 5) different portions of the sky. Each of the specified attitudes
for F0 1 thru F0 4 will require one complete orbit. F0 5 will
require data collection for the remaining lifetime of the
IU/SIVB, and this may result in one or more orbits for this F0.

b) Minimum Scheduling Requirement

F0 1) Same as the baseline requirement
thru
F0 5)

c) Performance Redline

F0 1) Same as the baseline requirement
thru
F0 5)

Performance Conditions

F0 1) Activation of the experiment, which will include enabling of the
 thru experiment gas supply system, application of experiment power,
 F0 5) and deployment of the sensor, will occur as soon as possible
 after CSM separation and prior to the initial maneuver into
 orbit 1 configuration. It is highly desirable to have three
 orbits in which to accomplish this activation.

The initial orientation of the IU/SIVB will be with the longitudinal axis of the vehicle in the plane of the orbit and perpendicular to local vertical, with the IU end toward the flight direction. The following maneuvers will be performed to place the unmanned IU/SIVB in the specified attitude consistent with the IU/SIVB lifetime:

- Orbit 1 - A 45-degree roll placing a point midway between Position I* and Position IV* down, so that the S150 look direction points 27.5 degrees above the flight vector.
- Orbit 2 - A further 45-degree roll placing Position IV* down.
- Orbit 3 - A 90-degree roll in the opposite direction, placing Position I* down.
- Orbit 4 - A left 27-degree yaw so that Position I* points down and vehicle axis points into the northern orbital hemisphere.
- Orbit 5 - A right 54-degree yaw followed by a 90-degree roll so that Position IV* points down and the vehicle axis points into the southern orbital hemisphere.

Further Orbits - Data should continue to be collected in the orbit 5 position as long as the IU/SIVB lifetime permits, with no further maneuvers.

Ground commands will be required for control of the tape dumps and the Launch Vehicle Digital Computer (LVDC) memory dumps. Ground command capability to alter the time initiation of maneuver sequences and experiment discretes will be required.

*These positions are referenced to the launch vehicle coordinate system axis as follows:

- Z Position I
- +Y Position II
- +Z Position III
- Y Position IV

In-Flight Data

- a) Telemetry - Experiment measurements will be telemetered during real time and tape recorded by the Auxiliary Storage and Playback Unit for data dump at least once per orbit.

Spacecraft measurements with the exception of gas pressure measurements will be stored in the LVDC memory and telemetered when over ground stations at least once per orbit. Gas pressure measurements will be telemetered during real time only.

- b) Crew Voice Comments - None
- c) Log Books - None
- d) Photographs - None
- e) Return Payload - None

For additional details, refer to Appendix A.

Evaluation

Refer to Pre- and Post-Mission Scientific Data Analysis and Reporting Plan for MSFC Skylab Experiments.

Experiment S183

UV PANORAMA

Obtain color index of stellar objects.

Purpose and Background

The purpose is to obtain color indices of selected stellar objects in two bandpasses of approximately 600 angstroms half-power bandwidth, which are centered at approximately the 1800- and 3100- angstrom wavelengths, and another bandpass of approximately 365 angstroms half-power bandwidth which is centered at approximately the 2500-angstrom wavelength.

The stellar objects to be studied are individual hot stars which are distributed in different regions of the sky in relation to the Milky Way and collective groups of stars such as clusters, galaxy nuclei, and the stellar clouds in the Milky Way. The data obtained from this experiment will be used in the broad sense to determine galactic structure and galactic evolution. Specifically, the ultraviolet (UV) data of S183 will be combined with previously gathered X-ray, visible infrared, and radio spectral data to accomplish this objective. Correlation will also be made with the data of Experiment S019 so that comparisons of the spectra and color indices of certain starfields can be accomplished.

Functional Objectives

- Obtain UV photographs to determine the color index of stellar objects.

F0 1)	Obtain selective UV photographs of as many	(8%
thru	designated starfields as possible on darkside	each
F0 12)	passes.	F0)

Performance Requirements

a) Baseline Requirement

F0 1) Thirty-four UV film plate photographs of approximately 20 star-
thru fields are required. Twelve photographic periods (F0 1 thru
F0 12) F0 12) of at least 32 minutes duration will be scheduled during
night side passes. Photographic periods of less than 32 minutes
duration are acceptable, provided the lost time is made up during
other night side passes of greater than 32 minutes duration
or by scheduling photographic periods during additional night
side passes. One simultaneous Data Acquisition Camera (DAC)
photograph at 2500 angstroms is required with each of the 35-mm
plate photographs which record data at 1800 angstroms and 3100
angstroms; because of the scientific importance of the 2500-
angstrom bandpass of the DAC, photographs should be taken with
the DAC in case of an S183 Spectrograph Assembly failure.

b) Minimum Scheduling Requirement

F0 1) Eight photographic periods (F0 1 thru F0 8) during night side
thru passes of 32 minutes average duration are required.
F0 12)

c) Performance Redline

F0 1) Continue to schedule toward the minimum scheduling requirement.
thru
F0 12)

Performance Conditions

- FO 1) The potential starfields to be photographed will be updated by
thru computer based upon exact orbital conditions of the workshop.
- FO 12) The updated starfields, pointing coordinated (mirror tilt and
rotation angles) will be supplied to the crew 24 hours prior
to the experiment session.

The experiment will be operated through the anti-solar Scientific Airlock (SAL) using the S183 Spectrograph Assembly (S183 SA) and the S019 Articulated Mirror System (S019 AMS) in accordance with procedures contained in the appropriate checklist.

Two crewmen are required to handle the S183 SA during experiment preparation tasks and postoperation tasks.

It is estimated that three UV photographs can be taken during one orbital night side pass; therefore, 12 night passes will be required to permit the 34 UV film plate photographs to be obtained. UV photographs of the starfields will be made on 34 of 36 photographic plates contained in a film carousel (two plates were exposed prior to launch for control purposes). Simultaneous 16-mm DAC photographs of the starfields will be made to record scientific data to identify the field photographed with the S183 SA, and to permit an evaluation of the amount of regular drift. The DAC also records all photographic data at 2500 angstrom and, therefore, should continue to be used to record photographic data in the event of an SA failure.

Automatic exposure times from 20 seconds to 1260 seconds are available. The number of exposures in a starfield sequence and the exposure durations chosen will depend on the starfield brightness. The S183 SA will be controlled by internal logic after an operating sequence of one to three photographs is started.

It is highly desirable that the experiment be performed during dark side passes with durations exceeding 32 minutes, when the moon is less than half illuminated and when the Orbital Assembly (OA) is in an inertially stable mode, Solar Inertial Attitude (X-IOP/Z). The above constraint regarding illumination of the moon is to be used during preflight planning. If it becomes apparent during the mission that there will be insufficient time to permit exposing all of the S183 film within the above illumination constraints, then it may be permissible to relax the constraints in order to insure that all S183 films are used. Photographs obtained within 7 to 10 days from a new moon will represent approximately 50 percent achievement. Photographs obtained within 11 to 14 days of a new moon will represent approximately 30 percent achievement.

The AMS will be erected just before sunset and retracted just after sunrise.

In order to be able to correlate experiment data between S183 and S019 (photograph identical starfields with similar degradation to film and mirror system) it is highly desirable that at least one sequence of photos for S183 be obtained on an orbit

successive to an orbit where S019 is scheduled to obtain star-field photos. If successive orbits are not possible then the closest orbit possible will be satisfactory provided the time span is no greater than 24 hours.

The experiment line-of-sight shall be aligned to within 30 arc minutes of each of the selected starfields utilizing the S019 AMS.

Experiments M509 (Astronaut Maneuvering Equipment), T020 (Foot Controlled Maneuvering Unit) and T013 (Crew/Vehicle Disturbances) must not be operated while S019/S183 equipment is installed in the SAL.

Time correlation to within 1.0 second Greenwich Mean Time (GMT) will be required with the "Shutter Open" timing signal.

It is mandatory to inhibit Control Moment Gyro (GMG) desaturation maneuvers during exposures.

Crew motions are to be kept to a minimum during S183 exposures. Scheduling of crew activities (which may cause spacecraft movement, e.g., transfer of heavy equipment, exercises which require the crew to push off from the spacecraft wall, etc.) is to be avoided during S183 operation periods.

Moisture must not be allowed to condense on the S019 AMS.

Thruster Attitude Control Subsystem (TACS) firings will be minimized when the S019 AMS is extended. There will be no Service Module Reaction Control Subsystem firings when the S019 AMS is extended.

Venting from the following controllable external OA vents will be completed 30 minutes prior to and avoided during the performance of experiment photographic sequences:

- a) SWS blowdown or cabin atmosphere vent
- b) AM EVA vent
- c) CSM RCS
- d) AM condensate system vent (contingency)
- e) CSM vents from steam duct, urine dump, and waste water dump

External OA venting from the following operations will be completed 15 minutes prior to and avoided during the performance of experiment photographic sequences:

- a) M092
- b) M171

All OWS interior lights with the exception of those listed in the appropriate checklist must be turned off five minutes before the beginning of the experiment operation period and remain off throughout the entire period. Onboard pen lights, with red filters designed for use during S019 operation, are acceptable without restriction.

Any external lights of less than 6000 Å which might reflect into the experiment must be off during the operation of the experiment. All ports or windows which might reflect light of less than 6000 Å into the experiment must be covered.

The film carrousel and 16-mm film shall not be out of the film vault for more than a cumulative total of 96 hours (from initial removal of the film from the vault to the time of Command Module separation).

It is not necessary to remove the experiment from the SAL during the day portion of the orbit; however, the AMS should be retracted and the experiment should remain evacuated. To minimize exposure time to radiation, the film carrousel and 16-mm magazine must be removed and stored in the film vault when observing periods are separated by 12 hours. It is permissible to have the remainder of the experiment in the SAL during this period if the Blank Film Door is placed in the SA and the assembly is vented to space.

The film storage container containing the film carrousel must be evacuated immediately following each removal of the film carrousel and prior to stowage in the film vault to achieve a vacuum of 10 torr or less.

If it is necessary to remove the S183 SA from the airlock for more than 12 hours, it must be evacuated to 10 torr or less. If it is necessary to remove the S019 AMS from the airlock for more than 12 hours, it must be evacuated to 1 torr or less. Evacuation is to begin within 30 minutes of experiment disassembly.

It is necessary for the crewman operating the experiment to know when the dark portion of the orbit starts to within 1.0 minute.

In-Flight Data

- a) Telemetry - Time of shutter opening correlated to ± 1.0 second and film plate position are required for each photograph.
- b) Crew Voice Comments - The following will require voice comments or entry in the crew log (Items 1 thru 6 need only be recorded or logged if different from nominal):
 - 1) The exposure number
 - 2) Target field identification
 - 3) Time of initiation correlated to Greenwich Mean Time (GMT) to within 1 minute.
 - 4) Length of exposure
 - 5) DAC setting
 - 6) Pointing (mirror tilt and rotation angles)
 - 7) Comments on the quality of image tracking conditions and any other noteworthy conditions relative to the experiment

- c) Log Books - See Crew Voice Comments above.
- d) Photographs - Thirty-four UV film plate photographs of selected starfields taken with the Spectrograph Assembly and 35 photographs taken simultaneously with the 16-mm DAC
- e) Return Payload - Log book (if voice logging was not accomplished) and a film storage container enclosing a film carousel containing UV film plates and 16-mm film

For additional details, refer to Appendix A.

Evaluation

Refer to Pre- and Post-Mission Scientific Data Analysis and Reporting Plan for MSFC Skylab Experiments.

Experiment S230

MAGNETOSPHERIC PARTICLE COMPOSITION

Measure fluxes and composition of precipitating magnetospheric ions and trapped particles.

Purpose and Background

The purpose is to measure fluxes and composition of precipitating magnetospheric ions and trapped particles through the use of a foil collection technique.

The mechanisms of gain and loss of magnetospheric particles are still largely unknown. Although it is generally assumed that the source for most of the magnetospheric particles is the solar wind, there is very little experimental evidence to back this assumption. It is likely that at least a fraction of the energetic ions populating the magnetosphere is of atmospheric origin, having been carried upwards by the polar wind or by field-aligned acceleration. Measurements of the isotopic abundances of the noble gases (helium, neon, and argon) should aid in answering the question of origin of magnetospheric plasmas, and possibly trapped particles. The isotopic abundances of these elements are so different in the solar wind and in the atmosphere that even a small mixture of particles of one source to those of the other source can be distinguished.

The experiment equipment will consist of sheets of collecting foils mounted on a flexible backing material to make a collector assembly. Four separate collector assemblies will be mounted as two double cuffs around two spools mounted on a truss on the Apollo Telescope Mount (ATM) Deployment Assembly (DA) prior to the launch of SL-1. Each spool will have two collector assemblies mounted one on top of the other. Retrieval of these collector assemblies will occur during four ATM extravehicular activities (EVA), two each for SL-3 and SL-4.

Functional Objectives

● Determine the mission fluxes and composition of precipitating magnetospheric ions and trapped particles.

- FO 1) Retrieve one S230 collector assembly from the ATM (40% - FO 1)
- FO 2) DA during an ATM EVA. (60% - FO 2)

Performance Requirements

a) Baseline Requirement

- FO 1) The outer collector assembly of the aft spool will be retrieved on the first EVA.
- FO 2) The inner collector assembly of the aft spool will be retrieved on the last EVA.

Removal of the outer collector assembly (retrieved during performance of FO 1) must precede this FO.

b) Minimum Scheduling Requirement

- FO 1) Same as the baseline requirement
- FO 2)

c) Performance Redline

- FO 1) Same as baseline requirement
 FO 2)

Performance Conditions

- FO 1) An EVA astronaut will inspect and retrieve an Experiment S230
 FO 2) collector assembly during an ATM EVA in accordance with procedures contained in the appropriate checklist.

Anytime prior to retrieval, the collector assembly to be retrieved will be photographed (one frame of 35-mm or 70-mm operational film for each of two collector assemblies) through the Structural Transition Section window that provides the best view of the assembly.

Astronaut comments during the retrieval of the collector assembly will be recorded.

After retrieval, the collector assembly will be placed in the return collector pouch and temporarily stowed in the Skylab food freezer. The pouch containing two collector assemblies will be transferred to the Command Module (CM) just prior to completion of the mission.

Temperature of the collector assemblies during handling and stowage after retrieval must not exceed 90°F. The collector assemblies may be exposed to air, or to the normal Skylab atmosphere after retrieval, but they must be protected from excessive heat, humidity, salt spray, corrosive gases or liquids, and noble gases, and from X-ray, Alpha and Beta radiation in excess of that found in normal atmosphere.

In-Flight Data

- a) Telemetry - Spacecraft housekeeping telemetry will provide the following:
 - 1) Spacecraft attitude during experiment exposure
 - 2) Orbital location and attitude when not in solar inertial correlated to Greenwich Mean Time (GMT)
 - 3) Attitude and GMT when experiment foils are exposed to sunlight (they are shaded when the spacecraft is in solar inertial)
- b) Crew Voice Comments - The retrieving EVA crewman will voice record collector retrieval time correlatable to GMT.
- c) Log Books - None
- d) Photographs - One photograph before retrieval of outer collector assembly and one photograph before retrieval of inner collector assembly (operational film)

- e) Return Payload - One return collector pouch containing two collector assemblies (one outer and one inner type) will be returned. (Note: The film in support of Experiment S230 is included in the operational film budget as opposed to being part of the S230 return payload.)

For additional details, refer to Appendix A.

Evaluation

Refer to Pre- and Post-Mission Scientific Data Analysis and Reporting Plan for MSFC Skylab Experiments.

Experiment T002*

MANUAL NAVIGATION SIGHTINGS (B)

Obtain data on manual midcourse and orbit navigation.

Purpose and Background

The purpose is to investigate the effects of the spacecraft environment (long mission time and confinement) on a navigator's ability to obtain space navigation measurements through a spacecraft window using hand-held instruments. A second purpose is to demonstrate the operational feasibility of a manual navigation system consisting of a hand-held sextant (SXT) and stadimeter.

Experimental measurements of the angle between star pairs and between stars and the earth horizon were made using hand-held sextants in Gemini Experiments. This experiment will extend the Gemini results to include measurements of the star/lunar limb angle with a hand-held SXT and spacecraft altitude with a hand-held stadimeter.

Midcourse type navigation measurements using a hand-held SXT will be made during the dark portion of the orbit using star/lunar limb target combinations. Measurements of the angle between selected star pairs will also be made.

Orbital type navigation measurements using stars and earth horizon as targets will be made using a hand-held SXT. Hand-held stadimeter measurements will be made using the earth horizon as target.

Functional Objectives

- Investigate effects of long mission time and confinement on a navigator's ability to obtain space navigation measurements using hand-held instruments.

Demonstrate the operational feasibility of a manual navigation system.

F0 1) thru F0 6)	Perform six SXT sighting periods on a pair of known stars for midcourse type navigation.	(5% each F0)
F0 7) thru F0 18)	Perform 12 SXT sighting periods on a known star and the lunar limb for midcourse type navigation.	(1% each F0)
F0 19) thru F0 24)	Perform six SXT sighting periods on two portions of the lunar limb for midcourse type navigation.	(1% each F0)
F0 25) F0 26)	Perform two stadimeter sighting periods on the earth horizon for orbit type navigation.	(5% each F0)
F0 27) thru F0 29)	Perform three SXT sighting periods on the earth horizon and a known star for orbit type navigation.	(4% each F0)

*This experiment is to be performed at the convenience of the crew and on a non-interference basis with the other experiments.

- FO 30) Perform five SXT/stadimeter sighting periods con- (6%
thru sisting of SXT measurements on the earth horizon each
FO 34) and two known stars and stadimeter measurements FO)
on the earth horizon for orbit type navigation.

Performance Requirements

a) Baseline Requirement

- FO 1) Perform 34 sighting periods (FO 1 thru FO 34) consisting of
thru approximately 290 sextant measurements, 160 sextant calibration
FO 34) measurements, and 35 stadimeter measurements.

b) Minimum Scheduling Requirement

- FO 1) Not applicable since this experiment is to be performed at the con-
thru venience of the crew and on a non-interference basis with the other
FO 34) experiments.

c) Performance Redline

- FO 1) Not applicable
thru
FO 34)

Performance Conditions

- FO 1) Midcourse type navigation SXT sighting periods will be distributed
thru equally in time throughout the mission (preferred) or one-half of
FO 24) the sighting periods will be conducted during the first half of
the mission and one-half during the last half of the mission.

Midcourse type navigation sighting periods will be performed on one mission and by the same crewman.

A SXT sighting period will consist of a minimum of 10 SXT angle measurements within one night pass.

A SXT reference calibration consisting of five night SXT angle measurements of a single known star will be performed for each SXT sighting period.

- FO 7) Four SXT sighting periods will be performed with a 1.0 filter
thru setting, four with no filter, and four with a 1.6 filter setting.
FO 18) If the moon is too dim with the 1.6 filter, six sightings with no
filter and six sightings with the 1.0 filter will be made.

- FO 25) Perform 10 stadimeter measurements of the earth horizon during
FO 26) each sighting period.

- FO 27) Perform as many night SXT measurements of the earth horizon and
thru a known star as possible during each of three sighting periods.
FO 29)

- FO 27) The night earth horizon must be moonlit and visible from the
thru wardroom window.
FO 34)

F0 30) The following sequence of sightings for each orbital navigation
thru sighting period will be performed within one orbit:
F0 34)

- a) Perform a minimum of three daylight stadimeter sightings at approximately 15-minute intervals of the earth horizon upon entering the day portion of the orbit.
- b) Perform a SXT sighting using the first known star and the night earth horizon.
- c) Perform a SXT sighting using the second known star and the night earth horizon.
- d) Perform a SXT sighting using the first known star and the night earth horizon.
- e) Perform a SXT sighting using the second known star and the night earth horizon.

F0 1) The Orbital Workshop (OWS) must be on the night side of the orbit
thru for SXT sightings.
F0 34)

All midcourse and orbit type measurements will be performed at the wardroom window in accordance with procedures contained in the appropriate checklist.

External lights that affect viewing from the wardroom window will be off and the wardroom interior lights will be dimmed to allow viewing of starfields during the experiment performance.

In-Flight Data

- a) Telemetry - Spacecraft housekeeping measurements
- b) Crew Voice Comments - Voice recordings pertinent to experiment operations will be dumped to the ground during normal dumps. Voice data will include:
 - 1) Zero bias measurements of the SXT
 - a) Greenwich Mean Time (GMT)
 - b) Target used
 - c) Window line-of-sight location
 - d) Temperature
 - e) SXT readout
 - f) Comments
 - 2) SXT angle measurement (Midcourse and Orbit)
 - a) GMT at start and end of session
 - b) Temperature at start and end of session
 - c) Portion of lunar limb (when applicable)
 - d) Target identification
 - e) Window line-of-sight location

- f) Voice "mark" for each image alignment
 - g) Sextant readout
 - h) Diopter setting
 - i) Filter used
 - j) Reticle brightness
 - k) Comments
- 3) Stadimeter angle measurements
- a) GMT at start and end of session
 - b) Characteristics of horizon used
 - c) Voice "mark" for each image alignment
 - d) Stadimeter readout
 - e) Stadimeter stopwatch and astronaut chronograph reading
 - f) Reticle brightness
 - g) Filter used
 - h) Comments
- c) Log Books - None
- d) Photographs - None
- e) Return Payload - None

For additional details, refer to Appendix A.

Evaluation

Refer to Pre- and Post-Mission Scientific Data Analysis and Reporting Plan for MSFC Skylab Experiments.

Experiment T003

IN-FLIGHT AEROSOL ANALYSIS

Obtain particulate matter generation data.

Purpose and Background

The purpose is to measure the aerosol particulate matter concentration and distribution in the spacecraft as a function of time and location, and to collect and return to earth the aerosol particles and the logged data for postflight analysis.

Investigations regarding various optical methods of counting and sizing small aerosol particles having unknown indices of refraction have been conducted with the conclusion that the geometry used in the Aerosol Analyzer (AA) can identify particles primarily by size alone.

Functional Objectives

● Determine the concentration and size distribution of aerosol particles in the spacecraft as a function of time, and obtain samples of the particles collected during these measurements.

- | | | |
|--------------------------|--|-------|
| FO 1) | Operate the AA to obtain readings at Crew Station CS-11 (crew quarters at AA Stowage Container location), CS-10, CS-1B, CS-11 (crew quarters near air diffuser), CS-15, CS-16, and CS-11 (crew quarters at shower location) as early in the mission as possible. | (25%) |
| FO 2) | Operate the AA to obtain periodic readings in the stowage location in the crew quarters during the presleep and postsleep periods commencing with the first sleep period after performing FO 1. | (25%) |
| FO 3)
thru
FO 7) | Operate the AA to obtain readings at CS-10, CS-1B, and CS-11 (crew quarters near air diffuser) every 10 \pm 1 days after FO 1. | (15%) |
| FO 8)
thru
FO 12) | Operate the AA to obtain readings at CS-15 and CS-16 every 10 \pm 1 days after FO 1. | (15%) |
| FO 13)
thru
FO 19) | Operate the AA at CS-11 (crew quarters at shower location) immediately after doffing clothes in preparation for shower on seven shower occurrences. | (10%) |
| FO 20) | Operate the AA, at the crew's discretion, to obtain up to 20 readings, at any time interval or location to investigate suspected particle generation sources. | (10%) |

Performance Requirement

- a) Baseline Requirement

- FO 1) Seven readings
- FO 2) Two readings per day for FO 2 after accomplishing FO 1
- FO 3) Three readings for each FO
thru
FO 7)
- FO 8) Four readings for each FO
thru
FO 12)
- FO 13) One reading for each FO
thru
FO 19)
- FO 20) Twenty readings
 - b) Minimum Scheduling Requirement
 - FO 1) Same as the baseline requirement
 - FO 2) Two readings every other day after accomplishing FO 1
 - FO 3) Same as the baseline requirement
thru
FO 20)
 - c) Performance Redline
 - FO 1) TBD
 - FO 2) TBD
 - FO 3) TBD
thru
FO 19)
 - FO 20) TBD

Performance Conditions

- FO 1) As soon as practical (but not later than 5 days) after Orbital Workshop (OWS) activation, the experiment will be performed at CS-11 (crew quarters at AA stowage container location); CS-10 [center of Airlock Module (AM)/OWS hatch]; CS-1B [Command Module (CM) center couch]; CS-11 (crew quarters near air diffuser); CS-15 (wardroom); CS-16 (head); and CS-11 (crew quarters at shower location).
- FO 2) Upon completion of FO 1, the AA will be returned to the storage location and subsequent readings at CS-11 (crew quarters at AA stowage container location) will be taken during the presleep and postsleep periods throughout the duration of the mission.
- FO 3) On the 10th day after the measurements for FO 1, AA readings will
thru
FO 7) be taken for FO 3 at CS-10 (center of AM/OWS hatch); CS-1B (CM center couch) and CS-11 (crew quarters near the air diffuser). The readings will be repeated at intervals of 10 \pm 1 days for FO 4 thru FO 7.

- FO 8) On the 10th day after the measurements for FO 1, AA readings will
thru be taken for FO 8 at CS-15 (wardroom) before food preparation and
FO 12) also after meals; at CS-16 (head) immediately before use of the
sanitary facility and also after weighing of the wet fecal sample
bag, as part of Experiment M071 Mineral Balance, utilizing the
Experiment M074 Specimen Mass Measurement Device. The readings
will be repeated at intervals of 10 \pm 1 days for FO 9 thru FO 12.
- FO 13) Operate the AA to obtain readings at CS-11 (crew quarters at the
thru shower location) immediately after doffing clothes in preparation
FO 19) for shower at the first opportunity after completing FO 1 for FO 13.
Repeat on subsequent shower opportunities (occurring approximately
every 8 days) throughout the mission for FO 14 thru FO 19.
- FO 20) At the astronaut's discretion, up to 20 readings will be made dur-
ing the flight at times and positions the astronaut feels may be
a source of particulate generation.
- FO 1) All experiment operations will be conducted in accordance with
thru procedures contained in the appropriate checklist.
- FO 20) The AA may be hand held during all experiment runs except for
those at CS-11 (crew quarters at AA stowage container location)
which will be run with the AA mounted on its stowage container
slide. The AA air inlet will be pointed perpendicular to the
spacecraft longitudinal axis and away from the couch pad in the
CM.

In-Flight Data

- a) Telemetry - OWS temperature and humidity
- b) Crew Voice Comments - Comments relative to the operation and
conduct of the experiment are to be made by the crew as appro-
priate.
- c) Log Books - Entries will be made on the experiment log cards
noting the time at the start of the INITIATE CYCLE, AA channel
number, accumulated counts, and activity in progress for each
reading.
- d) Photographs - None
- e) Return Payload - Experiment log cards and Filter Insert Assembly
in container.

For additional details, refer to Appendix A.

Evaluation

Refer to Pre- and Post-Mission Scientific Data Analysis and Reporting
Plan for MSFC Skylab Experiments.

Experiment T013*

CREW/VEHICLE DISTURBANCES

Obtain data on crew motion disturbance characteristics and the Attitude and Pointing Control System.

Purpose and Background

The purpose is to obtain data on crew motion disturbance characteristics and performance of the Attitude and Pointing Control System (APCS).

This experiment will provide data to determine discrete and statistical (stochastic) crew motion disturbance characteristics and their effects on the in-flight performance on the first Control Moment Gyro (CMG) and experiment isolation systems flown on a manned spacecraft. Specifically, partial and total body motion of an astronaut subject will be measured by actual body instrumentation, Limb Motion Sensor (LIMS), and recorded by motion picture photographs. The applied forces and moments produced by the astronaut will be measured by the force measuring platforms of the Force Measuring System (FMS). Vehicle motions will be sensed by real-time ATM measurements and performance data will be obtained. All data will be telemetered to the earth and used to check the validity of information obtained from mathematical models and ground simulations.

Definition of zero-gravity crew motion disturbance characteristics is essential for defining allowable crew motions during the performance of experiments requiring very low acceleration levels or extreme pointing accuracies. Verification of analytical models of crew motion disturbances will permit their use in sizing, design, and simulation of control systems for future manned space missions.

Functional Objectives

- Determine crew motion disturbance characteristics and the effects on the spacecraft.

FO 1) Perform various body movements in the Orbital Workshop (OWS) using a LIMS and the FMS.

Performance Requirements

a) Baseline Requirement

FO 1) A crewman will perform various body movements, stationary motions and translations for approximately 36 minutes using the LIMS and FMS in the OWS. During the worst-case control system input task, the subject crewman will perform translation movements between the two Force Measuring Unit (FMU) platforms and another crewman will translate between the food locker and a point near the OWS film vault.

b) Minimum Scheduling Requirement

FO 1) Same as the baseline requirement, if scheduled (since this is a candidate experiment)

* Candidate experiment for this mission - refer to paragraph 2.3.4.1.1(b).

c) Performance Redline

FO 1) TBDPerformance Conditions

FO 1) During the main performance of the experiment, one crewman will conduct experiment operations with the second crewman monitoring. The crewman wearing the LIMS device will perform various stationary motions, per procedures contained in the appropriate checklist, while attached to one of the FMU platforms of the FMS in the OWS. The third crewman will remain motionless and will not take part in this part of the experiment.

Another portion of the experiment will utilize three crewmen, with one crewman performing translation movements between the two FMU platforms of the Force Measuring System, and another crewman soaring between the food locker and a point near the OWS film vault. This sequence is called the worst-case control system input task. The crewman wearing the LIMS device will perform the translation movements between the two FMU platforms of the FMS. The third crewman, without a LIMS device, will simultaneously translate between the food locker and a point near the OWS film vault.

The second crewman will operate the two 16-mm Data Acquisition Cameras for both of the above described portions of the experiment. Film and telemetry data time correlation will be accomplished by the "Time Correlation Sequence" crew procedure.

All experiment tasks will be performed once during the mission.

The anti-solar Scientific Airlock (SAL) must not be in use during experiment operations.

All equipment that may interfere with experiment performance must be cleared from the surrounding area during experiment performance.

During experiment performance, C&D panel No. 2-617 will preclude concurrent operation of Experiment T013 with Experiments M092, M093, M131, M171, S149, S183, M509, and T027/S073, due to tape recorder utilization.

All non-experiment related physical activity of the crew, including vehicle housekeeping functions, will be constrained for approximately 36 minutes during experiment data collecting.

During the experiment performance, the APCS must be in active status with the Orbital Assembly (OA) in the solar inertial mode and automatic CMG desaturation maneuvers inhibited.

Vehicle motions due to crewman movement will be sensed by real-time ATM measurements. Real-time telemetry transmission of APCS data is required for a minimum of five minutes during the worst-case control system input task to permit data transmission at 12 samples per second.

Experiment data are required by the Principal Investigator or his representative as soon as possible for a "Quick-Look" evaluation to determine if an experiment rerun is required. Consideration for rescheduling should be based on these priorities:

- 1) Rerun experiment as previously with any film that is available (same mission).
- 2) Rerun experiment as previously without film (same mission).
- 3) Rerun experiment on next mission with LIMS adjustment to astronaut.

In-Flight Data

- a) Telemetry - ATM measurements of vehicle motion, and experiment measurements
- b) Crew Voice Comments - Crewmen identification, task identifications, and comments on task performances
- c) Log Books - Crewman identification, task identifications, and comments on task performances will be recorded if voice logging of crew comments was not accomplished.
- d) Photographs - Sequence photographs of all activities utilizing the LIMS
- e) Return Payload - Log books (if voice logging was not accomplished) and two 400-foot 16-mm film cassettes

For additional details, refer to Appendix A.

Evaluation

Refer to Pre- and Post-Mission Scientific Data Analysis and Reporting Plan for MSFC Skylab Experiments.

Test a space locomotion device.

Purpose and Background

The purpose is to test and evaluate a research space locomotion device to provide confidence and valuable design information for future experimental hardware.

This experiment is a two-element exploratory program to provide design and operational experience with a test-bed unit which offers a combination of simplification, reliability, and performance capabilities not provided with other design approaches. The first element of this program is the ground-based zero-gravity simulation facilities which are used to carry out experiment definition, crew training, and engineering evaluation. The second element is the in-flight evaluation carried out in the Skylab Orbital Workshop. In carrying out this coordinated two-phase effort, it is expected that a much greater amount of information will be generated than would be derived from singular independent approaches. The in-flight portion will yield the most accurate zero-gravity evaluation, but is limited by the usable volume within the Orbital Workshop (OWS), the relatively short time available for testing, the small number of test variables and test subjects, and the high costs involved. The ground-based evaluation serves to overcome these shortcomings, but is hampered to an unknown degree by simulation artifacts imposed by the earth-gravity environment. By providing a commonality of experiment maneuvering tasks for the two elements, the uncertainties regarding the simulation validity can be reduced, thereby increasing the value of the ground-based facilities as a source of information for possible continued maneuvering systems research and development.

Functional Objectives

● Evaluate the Foot Controlled Maneuvering Unit (FCMU) by performing various unsuited and suited maneuvers.

- | | | |
|-------|--|-------|
| FO 1) | Perform various maneuvers (Mode I) while flying the FCMU in shirtsleeves. | (60%) |
| FO 2) | Perform various maneuvers (Mode IIA) while flying the FCMU suited, using the Life Support Umbilical (LSU). | (10%) |
| FO 3) | Perform various maneuvers (Mode IIB) while flying the FCMU suited, using a Secondary Oxygen Pack (SOP) in lieu of the LSU. | (30%) |

Performance Requirements

a) Baseline Requirement

- FO 1) One crewman will perform at least two acceptable Mode I runs for pitch, roll, yaw, translation across OWS and stop, translation across OWS and pitch, and dogleg translation across OWS. In addition, at least one acceptable Mode I run will be performed for the tumble maneuver and for the minimum control inputs measurements.

F0 2) The same crewman (as in F0 1) will perform at least two acceptable Mode IIA runs for pitch, roll, yaw, and translation across OWS and stop. In addition, one run will be performed for the minimum control inputs measurement.

F0 3) The same crewman (as in F0 1) will perform at least two acceptable Mode IIB runs for pitch, translation across OWS and stop, translation across OWS and pitch, and dogleg translation across OWS.

b) Minimum Scheduling Requirement

F01) None

F02) One crewman will perform one acceptable run of the five Mode IIA tasks.

F03) None

c) Performance Redline

F01) One crewman will perform one Mode I run for the first four of the eight tasks (i.e., pitch, roll, yaw, translate and stop).

F02) None

F03) None

Performance Conditions

F0 1) Mode I maneuvers will be performed by a crewman in all of the experiment tasks.

The Mode I maneuvers will be performed in accordance with procedures in the appropriate checklist to include the following types of tasks:

- a) Pitch 90°, stop, hold position, return
- b) Roll 90°, stop, hold position, return
- c) Yaw 90°, stop, hold position, return
- d) Translate across OWS and stop
- e) Translate across OWS and pitch 90° to approach target chest on
- f) Dogleg translation across OWS to the Force Measuring Unit (FMU)
- g) Tumble recovery
- h) Measurement of minimum control inputs.

The crewman will perform in the shirtsleeve mode using the backpack propulsion gas supply.

The time required for pretest and posttest operations, charging of three Propellant Supply Subsystem (PSS) bottles (two for use and one for spare), and battery charging, is approximately 164 minutes. Approximately 90 minutes will be required for flying time and debriefing.

- FO 2) Mode IIA maneuvers will be performed by the same crewman as in Mode I.

The Mode IIA maneuvers will be performed in accordance with procedures in the appropriate checklist to include the following types of tasks:

- a) Pitch 90°, stop, hold position, return
- b) Roll 90°, stop, hold position, return
- c) Yaw 90°, stop, hold position, return
- d) Translate across OWS and stop.
- e) Measurement of minimum control inputs.

The crewman will perform in the pressure-suited mode using the backpack gas supply, the Pressure Control Unit (PCU) and the LSU.

At least two Mode IIA runs will be attempted but do not have to be acceptable if problems are associated with the LSU constraints and not the pressure suit itself. In this case, Mode IIB runs may be initiated.

The time required for pretest and posttest operations, charging of two PSS bottles and battery charging is approximately 209 minutes. Approximately 55 minutes will be required for actual flying time and debriefing.

- FO 3) Mode IIB maneuvers will be performed by the same crewman as in Modes I and IIA.

The Mode IIB maneuvers will be performed in accordance with procedures in the appropriate checklist to include the following types of tasks:

- a) Pitch 90°, stop, hold position, return
- b) Translate across OWS and stop
- c) Translate across OWS and pitch 90° to approach target chest on
- d) Dogleg translation across OWS to the FMU.

The crew will perform the pressure suited mode as used for Mode IIA except that the LSU will be disconnected and SOP will be used to provide oxygen to the crewman. Approximately 20 minutes is the actual flying time portion of the test. The pre-test and posttest operations and the debriefing time are included in the time provided above for Mode IIA presuming that Mode IIB will be run immediately after Mode IIA. If, however, it becomes necessary to remove the pressure suit after Mode IIA, then an additional period of approximately 180 minutes will be required for pretest and posttest operations and debriefing for Mode IIB.

The performance of Mode IIB is contingent upon the availability of a usable SOP.

Experiment M509 (Astronaut Maneuvering Equipment) will have priority over experiment T020 for use of the first available SOP.

FO 1) The PSS and the battery provided with the M509 (Astronaut
thru Maneuvering Equipment) Automatically Stabilized Maneuvering Unit
FO 3) (ASMU) are required for this experiment. In addition, one SOP
is required for oxygen supply for FO 3 in lieu of using the LSU.
All of the maneuvering activities of the experiment will be
photographed. Data Acquisition Cameras (DAC's) will be operated
at two frames per second for all maneuvers except that two short
DAC sequences of 60 seconds each will be taken at 24 frames per
second to show operation of foot controls under conditions of
minimum control inputs for FO 1 and FO 2.

Approximately ten still photographs, using the 35-mm camera, will
be required showing the general experiment setup.

The maximum allowable spacecraft rate about any axis during an
experiment run will be 6 degrees/minute.

A near uniform atmospheric airflow is required across the
OWS floor during the performance of the experiment. Some of
the OWS fans will be turned off to limit the atmospheric flow
velocity to an average of 20 feet per minute over the performance
area.

Mode I must be scheduled at least two days prior to Mode IIA
to prevent over-pressurization of the workshop which would result
in loss of atmosphere gas through the workshop relief valve.

Experiments using the Scientific Airlock shall not be in place
during T020 operations.

The time the crewman will perform in each mode of operation is
summarized by Mode in the following table:

Experiment Run Time (Includes Flying and Debriefing)

<u>Mode</u>	<u>Time (Min.)</u>
I	90
IIA	55
<u>IIB</u>	<u>20 (or until SOP depletion)</u>
Total Run Time*	165 Minutes

Experiment T020 is assigned to mission SL-3 and to mission SL-4.
At least one of the two crewmen who performs experiment T020
will also perform one set of runs on experiment M509.

In-Flight Data

- a) Telemetry - Required telemetry measurements will be recorded on
the Airlock Module recorder for subsequent dumping to the ground.
- b) Crew Voice Comments - Comments made by the subject and observer
during each debriefing session during the experiment will be
voice logged.

* Note: Run times do not include pretest and posttest operations, char-
ging of PSS bottles, or battery charging.

- c) Log Books - None
- d) Photographs - Sequence and still photographic coverage
- e) Return Payload - Three 140-foot magazines of 16-mm film, one-half of a 400-foot cassette of 16-mm film, and approximately 10 still photographs using 35-mm film. (Note: The 400-foot cassette of film will be shared with Experiment M509.)

For additional details, refer to Appendix A.

Evaluation

Refer to Pre-and Post-Mission Scientific Data Analysis and Reporting Plan for MSFC Skylab Experiments.

Measure surface brightness and
polarization of nightglow and
spacecraft corona.

Purpose and Background

The purposes are: to measure the sky brightness background caused by solar illumination of the particulate contaminants found about the Orbital Assembly (OA); to measure the surface brightness and polarization of the skyglow over as large a portion of the celestial sphere as possible at several wavelengths in the visible spectrum; and to perform similar measurements at the terminator and with sunlight on the spacecraft to determine the extent and nature of the spacecraft corona.

The overlap in objectives of Experiments T027 (Contamination Measurement) and S073 (Gegenschein/Zodiacal Light) led to the design of a photometer system which would permit use of the same hardware by both experiments. Each time the photometer is used, it measures all the light in its field-of-view (FOV). Scattered light from contaminant material around the OA must be separated from the total measurement to analyze the skyglow (primarily zodiacal light and starlight). Similarly, quantitative study of contamination is not possible without knowing the characteristics of the skyglow. This similarity and the fact that both S073 and T027 require knowledge of contamination, starlight, and zodiacal light, allows one DTO to combine all the objectives of Experiment S073 with that portion of Experiment T027 which employs the Photometer System. A separate DTO covers the portion of Experiment T027 which employs the Sample Array System which has the objective of determining the change in optical properties of various transmissive windows, mirrors, and diffraction gratings due to the deposition of contaminants found about the OA.

The Photometer System will measure three parameters which fully characterize the radiation from the skyglow and the OA corona; i.e., the total brightness, the brightness of the polarized components, and orientation of the plane of polarization. Measurements pertaining to the skyglow (zodiacal light, Gegenschein, starlight, F-region airglow) are best performed on the dark side. Measurements on the sunlit side and at the terminator will be used to characterize the contaminant cloud and to provide information on the skyglow.

The principal method of collecting photometric data which will satisfy experiment objectives is to scan the areas under study (e.g., ecliptic plane, anti-solar direction, and other regions of the celestial sphere). Scanning will be accomplished using complex two-dimensional routines controlled by the experiment's automatic programmer. The automatic programmer has seven (0 through 6) operating conditions or modes. These modes define the actual electro-mechanical operation of the photometer system. Within each of these modes from one to five (a, b, c, d, e), specific programs are operated. These programs are defined by the specific target desired (Gegenschein, Ecliptic Poles, etc.).

Each program has associated with it specific operating conditions such as shaft (azimuth) and trunnion (elevation) angles, orbital position of program start, duration of performance, etc. A description of each program is given on the following pages.

MODE AND PROGRAM DESCRIPTION

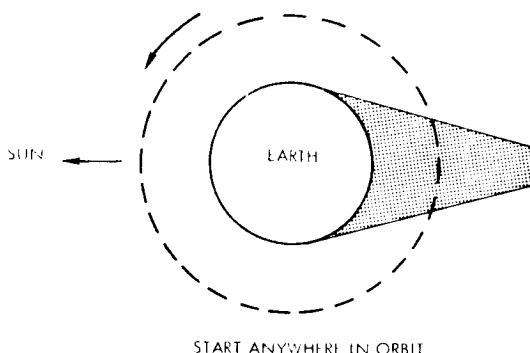
Mode 0 CALIBRATION

This mode is a calibration mode which may be performed with the photometer in any orientation. The instrument is capped and the photometer looks at a standard calibration source instead of the sky. Each of the 10 filters is used to observe this calibration source for a preselected (1 to 64) number of times. It is necessary to perform Mode 0 one time (10 filters, 2 minutes 5 seconds) prior to the start of every Mode 1 program. One calibration sequence is automatically performed at the conclusion of each sequence of Modes 2 through 5.

Program 0a System Monitor

This program is performed at any shaft (azimuth) and trunnion (elevation). The photometer is capped, and the sequence counter is used to cycle through the 10 filters continuously throughout an entire orbit. This program provides essential information on system precision and on typical effects of the changing thermal environment.

The program requires one orbit (94 minutes) to complete and may be started anywhere in the orbit.

Mode 1 FIXED POSITION

This mode is performed with the photometer in a fixed position. Sky observations are made for a preselected number of times with all filters in wheel A and Wheel B.

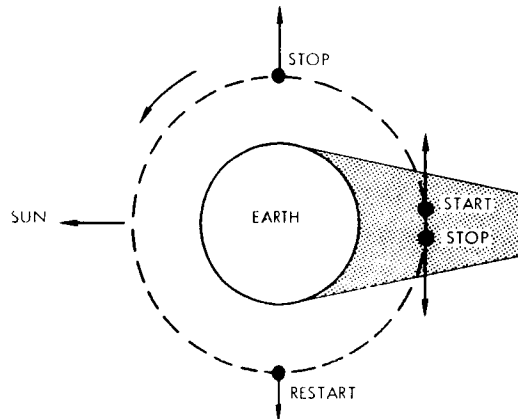
Program 1a Contamination

A change in brightness and, especially in polarization as the spacecraft leaves the earth's shadow, is a direct measure of the effect of the level of contamination (i.e., of the optical environment of the spacecraft). This program is capable of providing near real time information on contamination.

At any time this program is used, it can provide information on the zodiacal light at $+90^\circ$ elongation (angular distance from the sun). Comparison of observations in the ecliptic and at the ecliptic poles then gives a measure of the flattening of zodiacal dust toward the ecliptic.

This program is performed with the photometer pointed in a direction 90° from the direction to the sun. This direction is maintained from program initiation in the earth's shadow to a position in sunlight. At that time, other programs can be performed until the photometer is in an orbital position 180° from where it is stopped and is again pointed 90° from the sun. At this point a crewman changes the trunnion, the shaft being in the ecliptic, and restarts the program. The program then operates until it is in the earth's shadow where it is terminated.

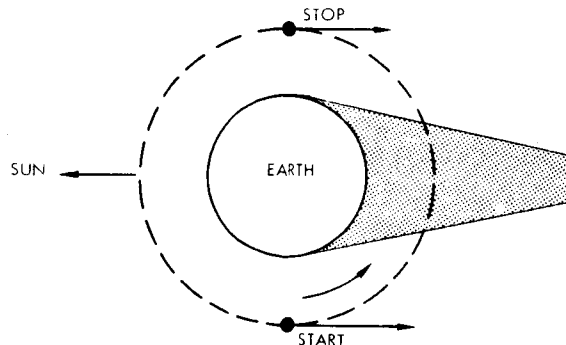
Each of the observation periods requires 20 minutes making 40 minutes the total time required to complete the program. These times do not include the Mode 0 calibration time.



Program 1b Gegenschein

This program is intended as a monitor of short-term (minutes) changes in brightness and of possible changes associated with the observing aspect with respect to the earth's shadow.

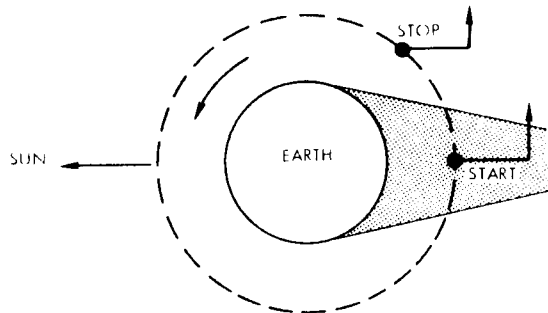
The program is performed with the photometer pointed in the anti-solar direction. The orbital positions for starting and stopping the program are shown below. The observation time is 48 minutes.



Program 1c Contamination

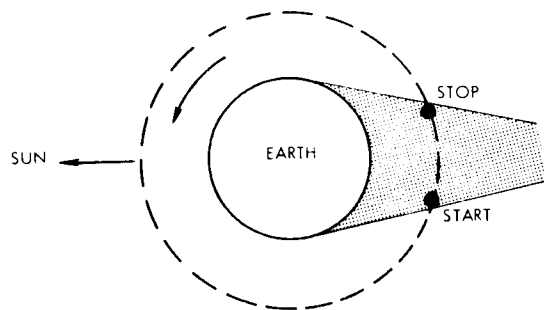
A preselected region which includes part of the OA is observed before, during, and after an overboard venting. The program starts prior to leaving the earth's shadow and continues for some time on the sunlit side.

The total observation time is 20 minutes not including the Mode 0 calibration time.

Program 1d Ecliptic Poles (N&S)

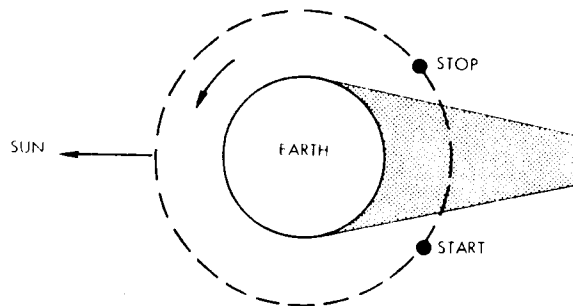
This program is performed from within the earth's shadow only. All 10 filters are used. The short duration dark periods resulting from high β angle orbits are well suited to this program.

The program requires 10-15 minutes to observe one pole (north or south).

Program 1e Celestial Poles (N&S)

This program is particularly important for relating OA observations to observations being obtained simultaneously from the ground support station at Hawaii. All 10 filters are used.

The program requires 30 minutes to observe one pole (north or south) and does not include Mode 0 calibration time.



Mode 2 VERTICAL CIRCLE

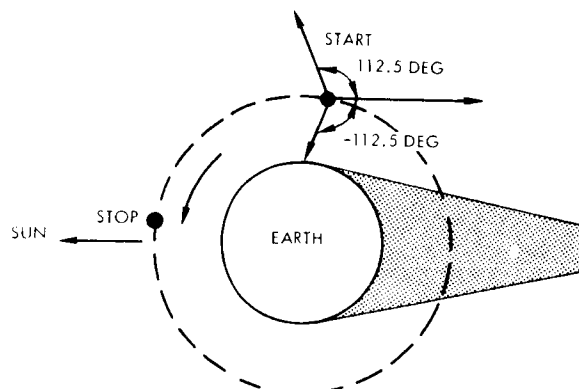
This mode performs vertical circle scans (scans in trunnion at fixed shaft). At the conclusion of a vertical circle scan, the shutter closes, the next filter moves into position, the shutter opens, and the photometer retraces its steps. This routine is continued until all the filters have been used. The shaft and range of scan in trunnion are preset, as are the number of sequences. Mechanical constraints make it impossible to scan in trunnion continuously through 0° (direction along the boom toward the sun or anti-sun). Therefore, at 0° trunnion, or at the appropriate limit (e.g., 15° when using the +Z [Solar] SAL), the trunnion scan stops, and the mount rotates in shaft before the trunnion scan continues (in reverse direction) to the other limit.

Program 2a In Ecliptic

This program is to provide information on contamination back-scattering and on the existence of a gegenschein parallax and is to be performed anywhere outside the earth's shadow.

The photometer scans in trunnion from 112.5° to the anti-solar point at a shaft corresponding to the ecliptic. It then rotates 180° in shaft with the shutter open and continues its scan to -112.5° .

The program requires 19 minutes to complete the observation with all filters.

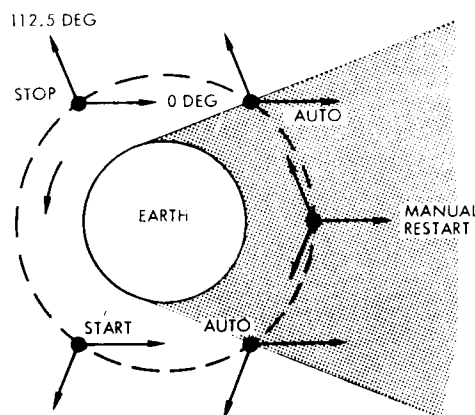


Program 2c Vertical Circle

In this program, the photometer scans in trunnion at a shaft corresponding to the ecliptic for at least one scan between the limits of 0° (the anti-solar point) and 112.5° . When the scan limit is reached, the photometer rotates 90° in shaft and scans in trunnion to the other limit. This operation is repeated for each of the 10 filters and requires 15 minutes. Each 15-minute scan is repeated four times during one orbit for a total of 60 minutes being required to complete the observation.

The program is started about 15 minutes before orbital darkness and is automatically repeated at the end of the first 15-minute scan. This results in one scan in sunlight and one scan in darkness. The shaft values are then manually changed and another two sequences are run.

Orbital conditions that result in at least a 30-minute dark side pass are highly desirable.

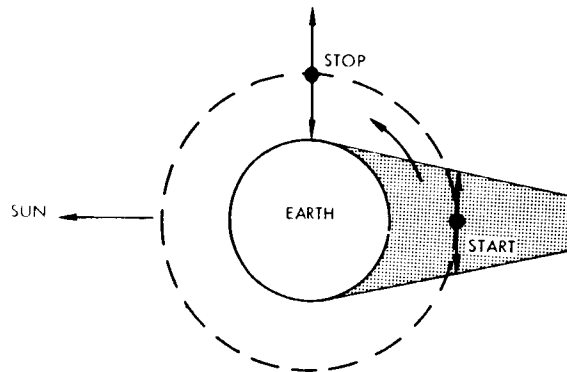
Mode 3 ALMUCANTAR

This mode performs almucantar scans (scans in shaft at fixed trunnion). At the conclusion of a scan in shaft, the shutter closes, the next filter moves into position, the shutter opens, and the photometer scans back along the same path. This routine is continued until all the filters have been used. The trunnion and range of scan in shaft are preset, as are the number of sequences.

Program 3a \perp to Ecliptic

This program is performed inside and outside the earth's shadow. The trunnion is preset to 90° and the photometer scans in shaft through its entire range, i.e., 0 to 354° , 354 to 0° , etc.

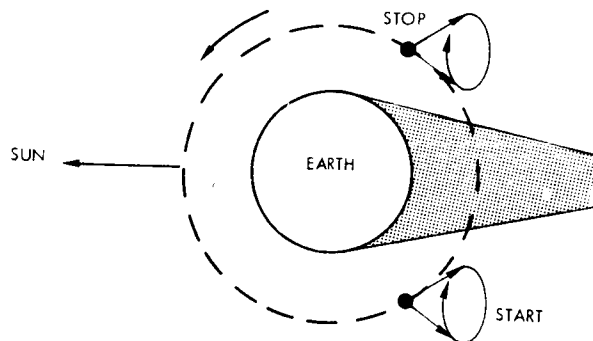
The program requires 17 minutes to complete the observation.



Program 3c Gegenschein

This program is performed in order to examine the wavelength dependence of the Gegenschein before changes in brightness occur. The program scans through the entire range of shaft at each of two trunnion angles (2.8° and 4.2°) using all 10 filters. The trunnion must be manually changed.

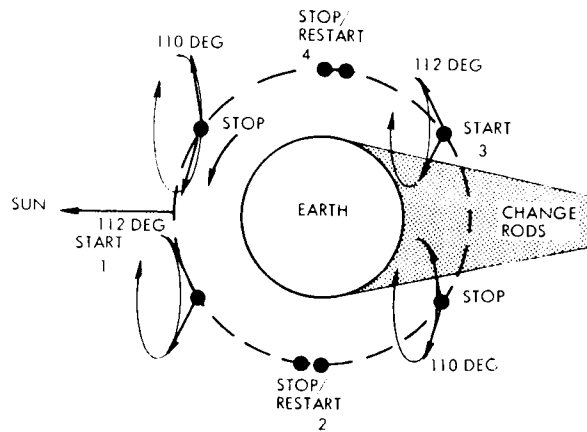
The program requires 34 minutes to complete including the manual changing of the trunnion angles.



Program 3d Contamination

The purpose of this program is to examine the wavelength dependence of the OA corona before any change in brightness occurs. The program is performed outside the earth's shadow and scans through the entire range of shaft at each of two trunnion angles, 112.5° and 110° , using all 10 filters. The trunnion angles are changed manually.

The program requires 34 minutes to perform and the program is to be performed twice: once with the photometer extended a length of 2 rods and once with the photometer extended a length of 7 rods. The total observation time, including manual trunnion changes, is 68 minutes and requires an astronaut to monitor intensity and change the gain.



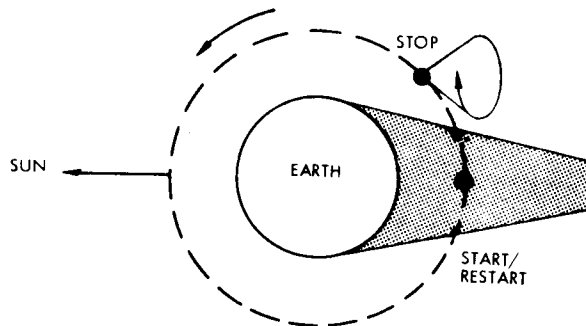
Mode 4 SKY MAPPING

This mode is used to provide detailed maps of limited regions, for example, near the Gegenschein or the sun by performing a series of almucantar scans (scans in shaft at fixed trunnion) separated in trunnion by 2.8° . A full mapping is performed with one filter before a mapping with another filter is started.

Program 4a Gegenschein

This program performs concentric scans about the anti-solar direction. The photometer scans over the entire range of 354° in shaft and from 2.8 to 28.1° in trunnion in steps of 2.8° for one filter. The entire scan is repeated for each of the 10 filters.

Each scan (1 filter) requires 16 minutes and is performed in an orbital position to keep the earth out of the field-of-view. It is desirable to perform part of the program in the earth's shadow but it should not be a constraint to the operation of the program. To complete the program using all 10 filters requires 160 minutes and 10 orbits.



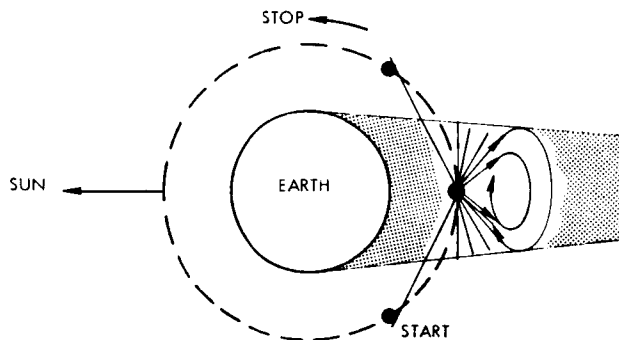
Mode 5 ALL SKY MAPPING

This mode is used to provide maps of the sky by performing a series of almucantar scans (scans in shaft at fixed trunnion) separated in trunnion by 5.6° . A full mapping is performed with one filter before a mapping with another filter is started.

Program 5a All Sky Map

This program performs concentric scans in the anti-solar direction. The photometer scans over the entire range of 354° in shaft and from 2.8 to 112.5° in trunnion in steps of 5.6° for one filter. The entire scan is repeated for each of the 10 filters.

Each scan (1 filter) requires 32 minutes. To complete the program using all 10 filters requires 320 minutes and 10 orbits.



Functional Objectives*

Measure the sky brightness background caused by solar illumination of the particulate contaminants found about the OA, measure the surface brightness and polarization of the skyglow over as large a portion of the celestial sphere as possible at several wavelengths in the visible spectrum and perform similar measurements at the terminator and with the sunlight on the spacecraft to determine the extent and nature of the spacecraft corona.

- FO 1) Perform System Monitor Program 0a (FO 1 and FO 2).
- FO 2)
- FO 3) Perform Contamination Programs 1a (FO 3, FO 4 and FO 5), 1c (FO 6),
- thru and 3d (FO 7).
- FO 7)
- FO 8) Perform In Ecliptic Program 2a (FO 8, FO 9 and FO 10).
- thru
- FO 10)
- FO 11) Perform Vertical Circle Program 2c (FO 11).
- FO 12) Perform All Sky Map Program 5a (FO 12).
- FO 13) Perform Celestial Pole (N) Program 1e (FO 13, FO 14 and FO 15)
- thru and Celestial Pole (S) Program 1e (FO 16, FO 17 and FO 18).
- FO 18)
- FO 19) Perform Gegenschein Programs 1b (FO 19, FO 20 and FO 21), 3c (FO 22
- thru and FO 23) and 4a (FO 24 and FO 25).
- FO 25)
- FO 26) Perform \perp to Ecliptic Program 3a (FO 26, FO 27 and FO 28).
- thru
- FO 28)
- FO 29) Perform Ecliptic Pole (N) Program 1d (FO 29) and Ecliptic Pole
- FO 30) (S) Program 1d (FO 30).

Performance Requirements

- a) Baseline Requirement
 - FO 1) Thirty performances of the Photometer System Programs as
 - thru presented in Table I are required.
 - FO 30)
- b) Minimum Scheduling Requirement
 - FO 1) Twenty performances of the Photometer System Programs as
 - thru presented in Table I are required.
 - FO 30)
- c) Performance Redline
 - FO 1) Continue to schedule toward the minimum scheduling requirement.
 - thru
 - FO 30)

*Due to the complex interrelationships between the various programs, it is impossible to assign a meaningful percentage value to each functional objective.

Performance Conditions

- FO 1) Program 0a (FO 1 and FO 2) will be performed twice during the mission.
FO 2)

When Program 0a performed for the first time (FO 1), it is mandatory that Program 1a (FO 3) be performed during the same deployment period. It is highly desirable that these initial performances occur prior to the beginning of ATM experiment operation.*

When Program 0a (FO 1 and FO 2) is performed, the photometer will be at 2 rods.

- FO 3) Program 1a (FO 3, FO 4 and FO 5) will be performed three times thru
FO 5)

When Program 1a is performed for the first time (FO 3), it is mandatory that Program 0a (FO 1) be performed during the same deployment period. It is highly desirable that these initial performances occur prior to the beginning of ATM experiment operation.*

During the entire first performances of Program 1a (FO 3), a crewman will be present to monitor intensity and change the gain if necessary.

For one-half (i.e., 20 minutes) of each performance of Program 1a (FO 3, FO 4 and FO 5) the photometer will be at 7 rods. The remaining half will be at 2 rods. The order of performance should be consistent with temperature requirements. Power and telemetry should be left on when changing rod lengths.

Whenever, Program 1a (FO 3, FO 4 and FO 5) is performed, the CMG dump will be inhibited.

- FO 6) Program 1c (FO 6) will be performed once during the mission.

Program 1c (FO 6) will be commenced prior to the initiation of a TBD contamination event and is to continue in operation during and after the contamination event.

Program 1c (FO 6) will be performed with the photometer at 2 rods.

- FO 7) Program 3d (FO 7) will be performed once during the mission.

Program 3d (FO 7) requires an astronaut to monitor intensity and change the gain, the trunnion, and the number of rods.

For one-half (i.e., 34 minutes) of the total performance of Program 3d (FO 7) the photometer will be at 7 rods. The remaining half will be at 2 rods. The order of performance should be consistent with temperature requirements.

Power and telemetry should be left on when changing rod lengths.

* This does not mean, however, that the start of ATM operations is in any way contingent upon the performance or results of T027/S073.

- FO 8) Program 2a (FO 8, FO 9 and FO 10) will be performed three times thru during the mission.
- FO 10) Program 2a (FO 8, FO 9 and FO 10) will be preformed with the photometer at 2 rods and the CMG dump will be inhibited.
- FO 8) Inertial orientation modes with random rates below 0.05 degree/ second are preferred. Constant rates up to 0.1 degree/ second
- FO 31) causing secular changes in orientation are acceptable if they do not result in a loss of the designated target. Generally, if the particular scan is fixed or moving in the opposite direction to the spacecraft, the target could be lost. A back and forth or circular scan probably would not result in a target loss. Angular accelerations which result in rates less than 0.5 degree/ second are acceptable.
- FO 11) Program 2c (FO 11) will be performed once during the mission. Program 2c(FO 11) will be performed with the photometer at 2 rods and the CMG dump will be inhibited.
- A dark side pass greater than 30 minutes in duration is highly desirable.
- FO 12) Program 5a (FO 12) will be performed once during the mission. Program 5a (FO 12) should be performed during the first deployment of the photometer because of the high priority of the program.
- Program 5a (FO 12) will be performed with photometer at 2 rods.
- Program 5a (FO 12) requires the use of orbital counter.
- If scheduling is a problem with Program 5a (FO 12) due to the 10 orbit requirement, the number of filters and hence the number of orbits may be reduced to eight.
- FO 13) Program 1e will be performed six times during the mission: three thru North Celestial Pole observations (FO 13, FO 14 and FO 15) and FO 18) three South Celestial Pole observations (FO 16, FO 17 and FO 18).
- The first two of these six performance will include both North and South Celestial Pole observations in any order, but separated by no more than two days. Likewise, the middle two and the last two of these six observations in any order, but separated by no more than two days.
- It is highly desirable that at least one North Celestial Pole (FO 13, FO 14 and FO 15) observation be within one week of the new moon and coordinated with ground observations at Hawaii.
- All observations will be made with the photometer at 2 rods and the CMG dump will be inhibited.

FO 19) Program 1b (FO 19, FO 20 and FO 21) will be performed three times
thru during the mission.
FO 21)

It is highly desirable that at least one performance of Program 1b (FO 19, FO 20 and FO 21) be made within one week of the new moon and coordinated with ground observations at Hawaii.

Program 1b (FO 19, FO 20 and FO 21) will be performed with the photometer at 2 rods and the CMG dump will be inhibited.

FO 22) Program 3c (FO 22 and FO 23) will be performed twice during the
FO 23) mission.

Program 3c (FO 22 and FO 23) requires a crewman to manually change the trunnion halfway through the program.

Program 3c (FO 22 and FO 23) will be performed with the photometer at 2 rods and the CMG dump will be inhibited.

FO 24) Program 4a (FO 24 and FO 25) will be performed twice during the
FO 25) mission.

Program 4a (FO 24 and FO 25) will be performed with the photometer at 2 rods.

Program 4a (FO 24 and FO 25) requires the use of the orbital counter and may be performed during a crew day off or a sleep period.

If scheduling is a problem with Program 4a (FO 24 and FO 25) due to the 10-orbit requirement, the number of filters and hence the number of orbits may be reduced to eight.

FO 26) Program 3a (FO 26, FO 27 and FO 28) will be performed three times
thru during the mission.
FO 28)

Program 3a (FO 26, FO 27 and FO 28) will be performed with the photometer at 2 rods and the CMG dump will be inhibited.

FO 29) Program 1d (FO 29 and FO 30) will be performed twice during the
FO 30) mission: one North Ecliptic Pole observation (FO 29) and one South Ecliptic Pole observation (FO 30). It is highly desirable that the North Ecliptic Pole observation (FO 29) be coordinated with ground observations at Hawaii.

Program 1d (FO 29 and FO 30) will be performed with the photometer at 2 rods and the CMG dump will be inhibited.

FO 1) Table I lists 30 desired performances of Photometer System Pro-
thru grams and their relative priority. It is desirable to perform
FO 30) the Photometer System Programs in relative order of priority, however, for flight planning convenience this is not an absolute requirement.

Table II summarizes some of the more salient conditions as they apply to scheduling the various programs.

The experiment will be mounted in the anti-solar SAL, the film magazine installed, and the photometer deployed per procedures contained in the appropriate checklist.

An astronaut will set up mode sequences, limit values for shaft and trunnion and other appropriate switches, and initiate the scan sequences. When other duties permit, however, it will be highly desirable for an astronaut to monitor detector signal levels and programmer functions and make verbal and/or written record relative to experiment operation. This particularly applies to any condition which might degrade results, such as changes in the optical environment around the OA.

T027/S073 shares the extension mechanism with S149 and the operational TV camera, and, therefore, cannot be scheduled concurrently.

When mounted in the SAL, the Photometer System will protrude into the operational volume required by M509 (Astronaut Maneuvering Equipment) and T020 (Foot Controlled Monitoring Unit). In addition, M509 will use the tape recorder used to record Photometer System data. T027/S073, therefore, should not be scheduled concurrently with M509 or T020.

When mounted in the SAL the photometer system will protrude into the operational volume required by the soaring performance of T013 (Crew/Vehicle Disturbances) and should not be scheduled concurrently.

T027/S073 cannot be scheduled concurrently with M092 (In-Flight Lower Body Negative Pressure), M093 (Vectocardiogram), M171 (Metabolic Activity) and any operational biomedical measurements due to the requirement for 320-sample per second data channels in the Airlock Module (AM).

The Photometer head temperature should be above the dewpoint before the film magazine is removed to avoid fog or frost on the optics and to prevent acceleration of corrosion due to excess moisture on precision surfaces and delicate components.

All exterior OA lights must be turned off and all OA and Command Module windows that would interfere with experiment operation must be covered during data collection.

Photographic data will be obtained from the 16-mm Data Acquisition Camera (DAC) which is in the photometer head of the Photometer System. Photographs will automatically be taken by the Photometer System by single frames during an observation program.

The film magazine will be placed in the Orbital Workshop (OWS) film vault before and after exposure and returned to earth in the Command Module (CM).

Solar inertial or any other known inertial orientation is most desirable.

Major maneuvers of the OA must not occur during experiment data collection.

After applying power to the Photometer System, a 5-minute warmup time is required prior to data collection.

The photometer shall not be pointed within 15 degrees of the moon or the sun during experiment data taking.

When the photometer is installed in the SAL, the electrical power is to be left on when not in a data taking mode.

The photometer must be inside the SAL with the SAL door closed during and for at least 15 minutes after any CSM RCS firing.

Use moderate hand torque when assembling Photometer System extension rods (approximately 40 in/lbs; design limit 160 in/lbs maximum).

All scans planned for a two-rod operation out the anti-solar SAL may be performed at seven rods if desired.

In-Flight Data

- a) Telemetry - The Photometer System parameters will be recorded for subsequent playback and transmission to the ground.
Selected OWS housekeeping parameters will be recorded for subsequent playback and transmission to the ground.
- b) Crew Voice Comments - Comments concerning experiment preparation, operation, and post-operational tasks will be recorded for subsequent playback and transmission to the ground.
- c) Log Books - None
- d) Photographs - 16-mm DAC photographs will be taken automatically by the Photometer System during the performance of a program.
- e) Return Payload - Three 16-mm film magazine assemblies.

For additional details, refer to Appendix A.

Evaluation

Refer to (Pre- and Post-Mission Scientific Data Analysis and Reporting Plan) for MSFC Skylab Experiments.

PRELIMINARY

Table I.

Desired Performance of Photometer System Programs

<u>Priority</u>	<u>Program</u>	<u>F0</u>
1	1a	3
2	0a	1
3	2a	8
4	1b	19
5	4a	24
6	5a	12
7	3a	26
8	1e(N)	13
9	1d(N)	29
10	1d(S)	30
11	3d	7
12	1e(S)	16
13	1b	20
14	2a	9
15	3c	22
16	1a	4
17	0a	2
18	1e(N)	14
19	1e(S)	17
20	3a	27
21	2c	11
22	4a	25
23	1c	6
24	1b	21
25	3c	23
26	2a	10
27	1e(N)	15
28	1e(S)	18
29	3a	28
30	1a	5

PRELIMINARY

Table II. Performance Conditions Summary

F0	Program	Number of Rods	Duration of Performance (min.)	CMG Dump Inhibit	Crew Requirements	Hawaii Coordination	New Moon + 1 Week	Remarks
1	0a	2	94					Highly desirable prior to AIM. F0 1 and F0 3 must be performed during same deployment period.
2	0a	2	94					
3	1a	2, 7	40	Yes	Monitor intensity, change rods			Highly desirable prior to AIM. F0 3 and F0 1 must be performed during same deployment period. Power and telemetry on during rod changes.
4	1a	2, 7	40	Yes	Change rods			Power and telemetry on during rod changes.
5	1a	2, 7	40	Yes	Change rods			Power and telemetry on during rod changes.
6	1c	2	20					To be coordinated with an external event.
7	3d	2, 7	68		Change trunnion Monitor intensity Change gain and rods			Power and telemetry on during rod changes.
8	2a	2	19	Yes				
9	2a	2	19	Yes				
10	2a	2	19	Yes				
11	2c	2	60	Yes	Change shaft			Greater than 30-minute dark side pass is highly desirable.
12	5a	2	320					Requires use of orbital counter.
13	1e(N)	2	30	Yes		Yes	Yes	The North and South Celestial Pole observations within F0 14 and F0 17, F0 15 and F0 18 and within F0 16 and F0 19 should be separated by no more than two days.
14	1e(N)	2	30	Yes		Yes	Yes	
15	1e(N)	2	30	Yes		Yes	Yes	
16	1e(S)	2	30	Yes				
17	1e(S)	2	30	Yes				
18	1e(S)	2	30	Yes				
19	1b	2	48	Yes		Yes	Yes	
20	1b	2	48	Yes		Yes	Yes	
21	1b	2	48	Yes		Yes	Yes	
22	3c	2	34	Yes	Change trunnion	Yes	Yes	
23	3c	2	34	Yes	Change trunnion	Yes	Yes	
24	4a	2	160					Requires use of orbital counter. May be performed during day off or sleep period.
25	4a	2	160	Yes				Requires use of orbital counter. May be performed during day off or sleep period.
26	3a	2	17	Yes				
27	3a	2	17	Yes				
28	3a	2	17	Yes				
29	1d(N)	2	15	Yes		Yes		North Ecliptic Pole
30	1d(S)	2	15	Yes				South Ecliptic Pole

*All scans planned for a two-rod operation out the anti-solar SAL may be performed at seven rods if desired.

3.2.5 Student Investigations

3.2.5.1 General

Student investigations were selected from a national competition of high school students. These investigations are related to earth observations, astronomy, biology/physiology, behavioral science, zoology, botany, and physics.

3.2.5.2 Student Investigation Assignments

The student investigations assigned to the SL-3 mission are:

ED11*	Atmospheric Absorption of Heat
ED12*	Volcanic Study
ED21	Libration Clouds
ED22*	Objects Within Mercury's Orbit
ED25	X-Rays From Jupiter
ED32	In Vitro Immunology
ED52	Web Formation
ED63	Cytoplasmic Streaming
ED74	Mass Measurement
ED76	Neutron Analysis

The student investigation DT0's (except for ED76) are presented in alphanumeric order on the following pages. A DT0 for ED76 has not been included since the six neutron flux detectors, to be retrieved at the end of the SL-4 mission, are to be deployed during the SL-1/SL-2 mission. Thus, no crew action is required for ED76 during the SL-3 mission.

* Candidate investigation for mission SL-3 - refer to paragraph 2.3.4.1.2.

Obtain infrared spectral data.

Purpose and Background

The purpose is to determine the attenuation of radiation in the visible and near IR regions caused by the earth's atmosphere over industrialized and non-industrialized sites.

S191 data taken over the 0.4 to 2.4 micron region will be used to attempt to determine the atmospheric attenuation of earth-reflected radiation. These data should be obtained from heavily populated and sparsely populated areas to assess the effects of natural and man-made phenomena on the atmosphere. These data will be used to determine if man-made atmospheric changes will contribute to long-term changes in the weather. The Skylab sensor data will be augmented by incident and reflected ground truth data as available.

Photographic data from S190A and S190B will be used to aid in the interpretation of the S191 data.

Functional Objectives

- Obtain Earth Resources Experiment Package (EREP) data to investigate the atmospheric attenuation of radiation in the visible and near IR regions.
- FO 1) Obtain S190A (Multispectral Photographic Cameras), S190B (Earth Terrain Camera), and S191 (Infrared Spectrometer) data from the White Sands, New Mexico area as available from other earth resources investigations. The coordinates of the area of interest are 32°40'-33°30'N; 106°08'-106°20'W.
- FO 2) Obtain S190A, S190B, and S191 data from the Houston Area Test Site (HATS) as available from other earth resources investigations. The coordinates of this site are 28°00'-31°00'N; 94°00'-97°00'W.
- FO 3) Obtain S190A, S190B, and S191 data from the four corners area (of New Mexico, Colorado, Utah and Arizona) as available from other earth resources investigations. The coordinates of this site are 36°42'N; 108°29'W.

Performance Requirements

a) Baseline Requirement

- FO 1) This investigation will be accomplished on a data duplication thru basis and no additional crew action over that necessary for the
- FO 3) baseline EREP observations is required for its implementation. Performance requirements for this investigation are the same as for baseline EREP experiments and are contained in Appendix B to this document.

b) Minimum Scheduling Requirement

- FO 1) Scheduling considerations and film requirements for this investigation thru will be dependent upon test conditions affecting the base-
- FO 3) line earth resources investigations; therefore, minimum scheduling requirements are not appropriate for ED11.

* Candidate investigation for this mission - refer to paragraph 2.3.4.1.2.

c) Performance Redline

F0 1) Not applicable; see (b) above.
thru
F0 3)

Performance Conditions

F0 1) This investigation will be accomplished on a data duplication
thru basis. Performance conditions for this investigation are
F0 3) identical to other earth resources investigations and are
contained in Appendix B to this document.

In-Flight Data

Data requirements are the same as for other approved earth resources investigations using these sites and are shown in Appendix B to this document.

Evaluation

These data will be used to determine the atmospheric attenuation of incident and reflected radiation when the atmosphere is in a natural state and when the atmosphere is modified by surface emissions.

Ground truth data on incident and reflected radiation as available will be compared with the Skylab sensor data to determine the extent of atmospheric attenuation.

Reporting will be conducted in accordance with Section 10 of the ED11 Experiment Requirements Document.

The Student Investigator will conduct this investigation in affiliation with appropriate EREP Principal Investigators.

The S190A, S190B, and S191 data will be processed by JSC prior to its delivery to the student.

Obtain thermal infrared data.

Purpose and Background

The purpose is to investigate the feasibility of predicting volcanic eruptions using thermal infrared data obtained by remote sensors.

Data from the Earth Resources Experiment Package (EREP) sensors will be used, with ground observations as available, to monitor heat changes in volcanic areas. The objective of this experiment is to determine if it is possible to predict with accuracy volcanic eruptions from spaceborne sensor data. This would permit the future establishment of a warning system similar to those used for meteorological predictions.

A number of volcanoes are currently monitored by observatories. The space acquired data would be used to supplement and/or confirm the observatory data.

Functional Objectives

- Obtain EREP data to determine the feasibility of using remote sensor thermal data to predict volcanic activity.

FO 1) Obtain S190A (Multispectral Photographic Cameras), S190B (Earth Terrain Camera), S191 (Infrared Spectrometer), and S192 (Multi-spectral Scanner) data from one or more of the following sites:

Concepcion, Nicaragua
11°32'N; 85°39'W

Masaya, Nicaragua
11°57'N; 86°09'W

Cerro Negro, Nicaragua
12°30'N; 86°30'W

Telica, Nicaragua
13°00'N; 86°00'W

Performance Requirements

a) Baseline Requirement

FO 1) This investigation will be accomplished on a data duplication basis except that S191 data will be obtained specifically for ED12. Thus performance requirements for this investigation are similar to EREP baseline volcano investigations and are contained in Appendix B to this document.

b) Minimum Scheduling Requirement

FO 1) Scheduling considerations and film requirements for this investigation will be dependent upon test conditions affecting the baseline volcano investigations; therefore, minimum scheduling requirements are not appropriate for ED12.

*Candidate investigation for this mission - refer to paragraph 2.3.4.1.2.

c) Performance Redline

F0 1) Not applicable; see (b) above.

Performance Conditions

F0 1) With the exception of activating the Infrared Spectrometer, performance conditions for this investigation are identical to the EREP baseline volcano investigations (i.e., the S190A Multispectral Photographic Cameras, S190B Earth Terrain Camera, and S192 Multi-spectral Scanner will be operated in accordance with sensor requirements specified for the baseline volcano investigations as detailed in Appendix B to this document).

Additionally, the S191 Infrared Spectrometer will be operated in the crew tracking mode during operation of the other sensors and cameras (S190A, S190B, and S192) required for this investigation.

In-Flight Data

Data requirements are the same as for other approved earth resources investigations using these sites, with the exception that S191 data must be recorded. The in-flight data requirements are shown in Appendix B to this document.

Evaluation

These data will be used to evaluate the determination of volcano thermal characteristics from space sensors. An investigation will be made to correlate these data with volcano activity predictions.

Reporting will be conducted in accordance with Section 10 of the ED12 Experiment Requirements Document.

The Student Investigator will conduct this investigation in affiliation with appropriate EREP Principal Investigators.

The S190A, S190B, S191, and S192 data will be processed by JSC prior to its delivery to the student.

Obtain dust accumulation data.

Purpose and Background

The purpose is to study two lunar libration regions to verify the accumulation of dust in these regions. Photography should reveal the existence of particle clouds collected due to the zero force field in the selected libration regions.

Additionally, data obtained in various portions of the earth's orbit around the sun will be used to determine variations in size or brightness, if any, of the clouds in these libration regions as a function of orbital position.

Functional Objectives

- Determine the existence of dust cloud accumulation in lunar libration regions (Lagrangian points L4 and L5) and their variation in size or brightness as a function of orbital position, through the use of S052 White Light Coronagraph data.

FO 1) Obtain S052 White Light Coronagraph data of lunar libration points (Lagrangian points L4 and L5).

Performance Requirements

a) Baseline Requirement

FO 1) The Scheduling Guidelines section of the Apollo Telescope Mount (ATM) Joint Observing Program 10 (JOP-10) specifies that ATM Building Block 1 (BB-1) or BB-2 is to be performed two times per orbit for each orbit that the libration cloud is in the field-of-view of S052 to gather lunar libration region data as dependent on solar conditions and film availability. ED21 will utilize S052 data from these observations.

b) Minimum Scheduling Requirement

FO 1) The scheduling of ATM JOP-10 by the ATM Principal Investigators will be dependent on solar conditions and film availability. ED21 will use whatever JOP-10 data are obtained; therefore, minimum scheduling requirements are not appropriate.

c) Performance Redline

FO 1) Not applicable; see (b) above.

Performance Conditions

FO 1) This investigation will utilize data obtained from an existing baseline experiment with no modification in hardware or procedures. This investigation, therefore, does not impact mission requirements and is classified as a data duplication investigation. The Performance Conditions are identical to those delineated in the Scheduling Guidelines portion of the ATM JOP-10 section of this document.

In-Flight Data

- a) Telemetry - None
- b) Crew Voice Comments - None
- c) Log Books - None
- d) Photographs - Photographs from Experiment S052 (White Light Coronagraph)
- e) Return Payload - None. (Note: Appropriate film will be part of the Experiment S052 return payload.)

For additional details, refer to Appendix A.

Evaluation

The data obtained from Experiment S052 (White Light Coronagraph) will be utilized to verify the accumulation of dust in the lunar libration regions, if any, and to determine the variation in size or brightness of the dust cloud, if any, as a function of the earth's orbital period.

The Student Investigator (SI) will be affiliated with Dr. Robert MacQueen of the High Altitude Observatory, Boulder, Colorado, and the observatory will provide appropriate photographs for evaluation by the SI.

Reporting will be conducted in accordance with Section 10 of the ED21 Experiment Requirements Document.

Obtain coronagraphic data.

Purpose and Background

There have been unconfirmed reports of sightings of objects within the orbit of the planet Mercury. The Skylab Program offers an opportunity for a clear and undistorted view of the portion of Mercury's orbit near the Sun. The Skylab mission will allow the long-term observations and periodic photography required for the purpose of detecting such objects, if any, in Mercury's orbit.

Functional Objectives

- Obtain data to be used to investigate reports of objects within the orbit of the planet Mercury.

FO 1) Obtain S052 White Light Coronagraph data of the interior portion of Mercury's orbit.

Performance Requirements

a) Baseline Requirement

FO 1) Apollo Telescope Mount Joint Observing Program 6 (ATM JOP-6), Synoptic Observations of the Sun, requires that S052 be operated as part of ATM Building Block 1 (BB-1) two times per day. Additionally, it is desired that S052 be operated as part of BB-2 once every two hours throughout the manned portion of the mission. ED22 will utilize S052 data from these observations when Mercury's orbit is within the S052 field of view. Additional information regarding this investigation is provided in the ATM JOP-6 section of this document.

b) Minimum Scheduling Requirement

FO 1) The scheduling of ATM JOP-6 by the ATM Principal Investigators will be dependent on solar conditions and the amount of film available. ED22 will use whatever JOP-6 data are obtained, and, therefore, minimum scheduling requirements are not appropriate.

c) Performance Redline

FO 1) Not applicable; see (b) above.

Performance Conditions

FO 1) This investigation will utilize data obtained from an existing baseline experiment with no modification in hardware or procedures. This investigation, therefore, does not impact mission requirements and is classified as a data duplication investigation. The Performance Conditions are identical to those delineated in the Scheduling Guidelines portion of the ATM JOP-6 section of this document.

* Candidate investigation for this mission - refer to paragraph 2.3.4.1.2.

In-Flight Data

- a) Telemetry - None
- b) Crew Voice Comments - None
- c) Log Books - None
- d) Photographs - Photographs from Experiment S052 (White Light Coronagraph)
- e) Return Payload - None. (Note: Appropriate film will be part of the Experiment S052 return payload.)

For additional details, refer to Appendix A.

Evaluation

The data obtained from the White Light Coronagraph will be utilized by the Student Investigator (SI) in an attempt to locate objects within the orbit of the planet Mercury.

The SI will be affiliated with Dr. Robert MacQueen of the High Altitude Observatory, Boulder Colorado, and the observatory will provide appropriate photographs for evaluation by the SI.

Reporting will be conducted in accordance with Section 10 of the ED22 Experiment Requirements Document.

Student Investigation ED25

X-RAYS FROM JUPITER

To Be Supplied.

Determine the effects of zero gravity on antigenicity in vitro.

Purpose and Background

The purpose of this investigation is to determine the effect of zero gravity on the antigen-antibody reaction.

The antigen-antibody reaction is the immune-response mechanism which helps man to protect himself against certain infections. This process will be tested by reacting human antigen against an agar suspension of specific antibodies.

The antigen will be injected into immunodiffusion plates containing the agar. The antigen will diffuse through the plates forming a precipitate which will appear as a cloudy white ring surrounding the hole. The diameter of the rings is a function of the concentration of the antigen and antibodies. Photographs of the rings in the agar will be returned to earth for analysis.

Functional Objectives

- Determine the effect of zero gravity on the antigen-antibody reaction.
- FO 1) Inject various concentrations of antigen into immunodiffusion plates, incubate, and photograph the resulting precipitin rings.

Performance Requirements

- a) Baseline Requirement
- FO 1) Three immunodiffusion plates will be inoculated with antigen and incubated. The resulting precipitin rings will be photographed.
- b) Minimum Schedule Requirement
- FO 1) Two immunodiffusion plates will be inoculated with antigen and incubated. The resulting precipitin rings will be photographed.
- c) Performance Redline
- FO 1) One immunodiffusion plate will be inoculated with antigen and incubated. The resulting precipitin rings will be photographed.

Performance Conditions

- FO 1) The astronaut will perform the investigation in accordance with procedures contained in the appropriate checklist. Three pre-filled dispensers, containing diluted antigen, will be used to place the required amount of antigen in each of the cavities in three immunodiffusion plates. Each plate has six cavities. The two cavities in each plate nearest the "T" will be used for one concentration of antigen, the middle cavities will be used for a second concentration, and the remaining cavities will be used for a third concentration.

After the antigen has been placed in each cavity in the immunodiffusion plates, the covers will be closed and the plates will remain at cabin temperature for 24 \pm 2 hours.

Upon termination of the incubation period, the cover of each plate will be removed and the plate will be photographed using a 35-mm Nikon F camera with a 55-mm lens, a Nikon E-2 adaptor, and high speed Ectachrome film type S0168. Six photographs will be taken, two of each immunodiffusion plate.

The immunodiffusion plates and antigen are temperature sensitive. During the launch phase, the immunodiffusion plates and antigen will be kept in a passive cooler which will be launched in the Command Module (CM).

Once in orbit, the astronaut will transfer the passive cooler from the CM to the Orbital Workshop (OWS) food chiller for refrigeration until the investigation is performed. It is highly desirable that the passive cooler be transferred from the CM to the OWS food chiller within two days after launch of the CM and it is mandatory that transfer be accomplished within four days after launch of the CM.

The performance of this investigation must begin within 15 days after the launch of the CSM.

In-Flight Data

- a) Telemetry - Orbital Workshop (OWS) temperature
- b) Crew Voice Comments - Time of transfer of the passive cooler, inoculation of antigen, incubation period, and photographic observations
- c) Log Books - The same type of data defined under Crew Voice Comments above may be entered in crew logs in addition to or instead of crew voice records.
- d) Photographs - Six photographs of the precipitin rings on the immunodiffusion plates
- e) Return Payload - Log books (if voice logging was not accomplished) and one 50-frame cassette of 35-mm film (shared with ED52)

For additional details, refer to Appendix A.

Evaluation

The Student Investigator will compare the photographs of the immunodiffusion plates with ground control test photographs to determine the effects of zero gravity on the antigen-antibody reaction.

Reporting will be conducted in accordance with Section 10 of the ED32 Experiment Requirements Document.

Obtain data on spider web spinning process in zero gravity.

Purpose and Background

The purpose is to observe the web building process of the *Araneus diadematus* (cross) spider in the Orbital Workshop (OWS) environment.

The quality of a spider's web is a clue to the state of its neurological system. For example, spiders under the influence of caffeine construct an irregular and haphazard web, indicating hyperactivity of its neurological system. The results of this investigation may be used to determine if the spider can use its sense of touch to compensate for the loss of balance caused by the zero gravity environment. The quality of the web it spins will provide a clue to its reaction to a weightless environment.

Ground control investigations will be conducted for data correlation purposes.

Functional Objectives

- Determine the effects of zero gravity on the spider web building process.

F0 1) Obtain motion pictures of the web building process.

F0 2) Observe and obtain still photographs of webs.

Performance Requirements

a) Baseline Requirement

F0 1) Obtain motion picture records of the web spinning process for a maximum of 20 days or until motion pictures of three web building processes have been obtained or until one 400-foot cassette of 16-mm film is exposed.

F0 2) Obtain three still photographs each of three webs.

b) Minimum Scheduling Requirement

F0 1) Obtain motion pictures of two of the web building attempts if web building is not successful, or motion pictures of one web building process if a web is spun.

F0 2) Obtain three still photographs each of two webs.

c) Performance Redline

F0 1) Obtain motion pictures of one web building process or one attempt at web building.

F0 2) Obtain one still photograph of one web.

Performance Conditions

- FO 1) The investigation will be activated (cage deployed, camera and Automatic Camera Actuator turned on, and the spider released from its vial) in accordance with the appropriate checklist as early in the mission as possible and no later than three days from CSM launch.

The equipment will be deployed in the forward dome area for a maximum of 20 days. If no evidence of web spinning is observed within 20 days of the release of the spider, the investigation may be terminated.

Two spiders will be launched. If the first spider released remains inactive for a period of approximately 10 days (no webs spun and no film exposed) it should be returned to its vial and the second spider released for the remainder of the investigation period.

It is desirable that the light intensity in the forward dome area be reduced to the minimum possible level during crew sleep periods while Student Investigation ED52 is activated.

- FO 1) The web spinning process shall be recorded by a Data Acquisition Camera (DAC) operated by the Automatic Camera Actuator at 6 frames/sec using one 400-ft film cassette.

The DAC and Automatic Camera Actuator will be activated for a maximum of 20 days or until 1) motion pictures of three web spinning processes have been obtained or 2) the 400 feet of 16-mm film allocated for this investigation have been exposed.

All of the ED52 hardware may be stowed in an out of the way location during conduct of Experiments M509 (Astronaut Maneuvering Unit) and T020 (Foot Controlled Maneuvering Unit).

- FO 2) Except on crew off-duty days, a crewman will check the spider cage once each day from the time the investigation is deployed until the first web has been built. Once a web has been built, it will be photographed three times with the 35-mm still camera.

After the first web has been built, one of the following conditions will exist:

- a) If FO 1 has been completed, a crewman will check the spider cage every other day and obtain three still photographs each of up to two subsequent webs.
- b) If FO 1 has not been completed, a crewman will check the spider cage every day and obtain three still photographs each of up to two subsequent webs.

These observations will be continued until a total of three webs have been built or until a total of 20 days has elapsed from the time of investigation activation.

In-Flight Data

- a) Telemetry - None
- b) Crew Voice Comments - The following will be voice recorded for subsequent play-back and transmission to the ground:
 - 1) Time of observation of the spider cage
 - 2) Comments regarding presence or absence of web
 - 3) Time of obtaining still photographs of webs
 - 4) Quantity of 16-mm film expended at each observation
- c) Log Books - The same type of data defined under crew voice comments above may be recorded in crew logs in addition to or instead of crew voice records.
- d) Photographs - A maximum of one 400-ft magazine of 16-mm film and a maximum of nine 35-mm still photographs
- e) Return Payload - Log books (if voice logging was not accomplished) and one 50 frame cassette of 35-mm film (shared with ED32) and one 400-ft cassette of 16-mm film

For additional details, refer to Appendix A.

Evaluation

The Student Investigator shall perform a similar ground investigation using applicable flight parameters and compare the results with those obtained in flight.

Reporting will be conducted in accordance with Section 10 of the ED52 Experiment Requirements Document.

Observe cytoplasmic streaming in a zero gravity environment.

Purpose and Background

The purpose of this investigation is to observe the effects of zero gravity on the cytoplasmic streaming of the elodea plant.

This streaming phenomenon is apparently involved in the metabolic functions of the cell. Energy distribution, chloroplast orientation for photosynthesis, and transportation of other cellular contents are involved. This investigation may provide basic insight into cellular function.

Functional Objectives

● Determine the effects of zero gravity on the cytoplasmic streaming of the elodea plant.

- FO 1) Observe and photograph cytoplasmic streaming of the elodea plant seven to ten days after launch of the Command Module (CM).
- FO 2) Observe and photograph cytoplasmic streaming of the elodea plant 15 to 18 days after launch of the CM.
- FO 3) Observe and photograph cytoplasmic streaming of the elodea plant 23 to 30 days after launch of the CM.

Performance Requirements

a) Baseline Requirement

- FO 1) Observe and photograph cytoplasmic streaming of the elodea plant
- FO 2) three times during the mission.
- FO 3)

b) Minimum Scheduling Requirement

- FO 1) Observe and photograph cytoplasmic streaming of the elodea plant
- FO 2) two times during the mission, once seven to ten days after launch
- FO 3) of the CM, and once 13 to 30 days after launch of the CM.

c) Performance Redline

- FO 1) Observe and photograph cytoplasmic streaming of the elodea plant
- FO 2) once during the mission.
- FO 3)

Performance Conditions

- FO 1) The astronaut will observe and photograph cytoplasmic streaming of the elodea leaf cells 7 to 10 days after launch of the CM. Following this observation, the microscope slide, cover slip, and vial of elodea used for this observation will be disposed of in the trash airlock and the tweezers will be cleaned with a bio-wipe.

- F0 2) The astronaut will observe and photograph cytoplasmic streaming of the elodea leaf cells 15 to 18 days after launch of the CM. Following this observation, the microscope slide, cover slip, and vial of elodea used for this observation will be disposed of in the trash airlock and the tweezers will be cleaned with a biowipe.
- F0 3) The astronaut will observe and photograph cytoplasmic streaming of the elodea leaf cells 23 to 30 days after launch of the CM. Following this observation, all ED63 equipment will be disposed of in the trash airlock.
- F0 1)
F0 2)
F0 3) The astronaut will perform the cytoplasmic streaming observations in accordance with procedures contained in the appropriate checklist.

Within three days after launch of the CM, the astronaut will deploy three vials, each containing a spring of elodea, in an area which will provide approximately 20 foot-candles of illumination. This level of illumination should be provided for at least 14 hours per day for the duration of the investigation (~ 30 days).

A spotmeter reading of the light intensity impinging on the vials will be taken in accordance with the appropriate checklist at the time the vials are deployed.

Prior to opening the vials, the astronaut will examine the contents for overgrowth of microbes (not algae). If excessive growth of microbes is noted, the vials will be disposed of in the trash airlock.

The astronaut will prepare a microscope slide of an elodea leaf from the most viable plant for each of the observations. Prior to an observation, the prepared slide will be held as close as possible to an Orbital Workshop (OWS) light source for a period of approximately 2 minutes to stimulate streaming.

The astronaut will observe and photograph cytoplasmic streaming of the elodea leaf cells at 400X magnification with the IMSS microscope, microscope adapter, and data acquisition camera (DAC) combination.

The astronaut will expose a maximum of 50 feet of 16-mm film at a frame rate of 6 frames per second during each of the three observations.

In-Flight Data

- a) Telemetry - None
- b) Crew Voice Comments - The following will be voice recorded for subsequent play-back and transmission to the ground:
 - 1) The duration of the streaming stimulus if other than 2 minutes
 - 2) Time of each photomicrographic observation
 - 3) Spotmeter reading
 - 4) Any unusual conditions observed

- c) Log Books - Same type of data as defined under Crew Voice Comments above may be recorded in crew logs in addition to or instead of crew voice records.
- d) Photographs - A maximum of 150 feet of 16-mm film
- e) Return Payload - Log books (if voice logging was not accomplished) and one 400-foot cassette of 16-mm film containing a maximum of 150 feet of film exposed during ED63 operation (shared with ED74)

For additional details, refer to Appendix A.

Evaluation

The Student Investigator will compare the in-flight results with those obtained in ground control tests to determine the effects of zero gravity on cytoplasmic streaming.

Reporting will be conducted in accordance with Section 10 of the ED63 Experiment Requirements Document.

Determine mass using a cantilevered spring beam.

Purpose and Background

The purpose is to demonstrate the use of the laws governing simple harmonic motion to measure the mass of a small object. A cantilevered spring beam will be firmly attached to a selected rigid structure within the Orbital Workshop (OWS). The free end of the beam will incorporate a simple holding device. The mass to be measured will be attached to the beam, the beam given an initial deflection, and the period of the oscillations measured by an electronic counter. The period of the oscillations will be correlated to a mass measurement using an onboard calibration curve. The accuracy of the calibration curve will be verified using calibrated masses.

Functional Objectives

● Demonstrate the capability of a cantilevered spring beam to determine mass in a zero gravity environment.

FO 1) Perform measurements of specified masses and obtain photographic data.
FO 4)

Performance Requirements

a) Baseline Requirement

FO 1) Four mass measurements will be conducted using up to six masses;
thru one using only the calibration mass and three using combinations
FO 4) of additional test masses.

b) Minimum Scheduling Requirement

FO 1) Two mass measurements will be performed; one for the calibration
thru mass and one for a combination of test masses.
FO 4)

c) Performance Redline

FO 1) One mass measurement will be conducted using the calibration
thru mass.
FO 4)

Performance Conditions

FO 1) Mass measurements will be conducted, and photographic and mass
thru comparison data obtained in accordance with procedures contained
FO 4) in the appropriate checklist.

The test hardware contains six masses of approximately 100 grams each which can be configured into the equivalent of five investigation masses. A maximum of four combination of test masses will be used for this investigation.

DAC photography at 24 frames per second will be required of the initial beam deflection and for approximately 50 subsequent oscillations of the beam and mass. The electronic

counter display will be positioned in the DAC field of view during the filming sequences. A maximum of 250 feet of film may be used. The Mass Measurement investigation requirements will be selected from the following table:

Total Mass (Grams)	Period of Oscillation (Sec)	Duration of Photography Sequence (Sec)	Number of Oscillations Observed
~200*	0.59	30	~50
~300	0.72	35	~50
~400	0.83	40	~50
~505	0.92	45	~50
~608	1.01	50	~50

* Calibration Mass consisting of two masses.

The magnitude of each mass will be determined using the electronic counter and a calibration curve to be contained in the crew checklist.

It is highly desirable that this investigation be covered as part of the Educational Television Program and that the performing crewman describe the experiment during its operation.

In-Flight Data

- a) Telemetry - None
- b) Crew Voice Comments - The following will be voice recorded for subsequent play-back and transmission to the ground:
 - 1) The period of oscillation for each mass as read from the electronic counter display
 - 2) The magnitude of the masses as read from the calibration curve
 - 3) Any comments related to conduct of the investigation
- c) Log Books - Same type of data as defined under Crew Voice Comments above may be recorded in crew logs in addition to or instead of crew voice records.
- d) Photographs - Up to 250 feet of 16-mm film
- e) Return Payload - Log books (if voice logging was not accomplished) and one 400-foot cassette of 16-mm film (shared with ED63)

For additional details, refer to Appendix A.

Evaluation

The Student Investigator will analyze the film data and compare the results with predicted values.

Reporting will be conducted in accordance with Section 10 of the ED74 Experiment Requirements Document.

3.3 SUBSYSTEM/OPERATIONAL DTO's

3.3.1 General

Subsystem/operational DTO's contained herein have been approved by Level II CCB action prior to incorporation into the MRD. Subsystem/operational DTO's are activities designed to provide data for real-time and/or postflight evaluation of subsystems operation or for real-time mission operations planning.

3.3.2 Subsystem/Operational DTO Assignments

The subsystem/operational DTO's are numbered in accordance with the following system with decimal numbers running chronologically from 0.1 to 0.n.

1.0	CSM	Guidance and Navigation
2.0	CSM	Attitude Control
3.0	CSM	Propulsion
4.0	CSM	Environmental Control
5.0	CSM	Electrical Power
6.0	CSM	Communications/Radar/Instrumentation
7.0	CSM	Thermal/Structures/Mechanical
8.0	CSM	Sequencing
9.0	CSM	Controls and Displays
11.0	SWS	Guidance and Navigation
12.0	SWS	Attitude Control
13.0	SWS	Propulsion
14.0	SWS	Environmental Control
15.0	SWS	Electrical Power
16.0	SWS	Communications/Radar/Instrumentation
17.0	SWS	Thermal/Structures/Mechanical
18.0	SWS	Sequencing
19.0	SWS	Controls and Displays
20.0		Operational

The subsystem/operational DTO's assigned to this mission are as shown in Table 3-3.

Table 3-3. Subsystem/Operational DTO Assignments

<u>DTO Number</u>	<u>Title</u>	JSC <u>Point of Contact</u>	<u>Originator</u>
20.10	Environmental Microbiology	R. E. Sanders/KM	J. K. Ferguson/DD5
20.11	Operational Radiation Measure- ments	J. M. Peacock/KM	J. V. Bailey/DD6
20.14	Orbital Assembly	J. M. Peacock/KM	C. M. Davis/SL-EI (MSFC)
	Contamination Assessment		
20.16	Water Sample	R. E. Sanders/KM	R. L. Sauer/DD6
20.17	Iodine Monitoring	R. E. Sanders/KM	R. L. Sauer/DD6
20.18	Carbon Monoxide Monitor	R. E. Sanders/KM	E. S. Harris/DD6
20.19	SLA Deployment Observation	F. C. Littleton/KM	F. C. Littleton/KM

Obtain in-flight microbiology samples.

Purpose and Background

The purpose is to obtain in-flight microbiology samples to support maintenance of the overall Saturn Workshop (SWS) habitability.

The data (FO 1 thru FO 4) to be obtained are mandatory to the assessment and maintenance of a suitable, safe SWS environment including equipment such as air filters and waste management facilities for the development of measures for prevention or control of potential crew illnesses on return visits.

Functional Objectives

- Obtain data to determine the presence and conditions of micro-organisms on hardware in various locations throughout the SWS.

FO 1) Obtain in-flight microbiological samples from SWS hardware 14 to 16
FO 2) days prior to the end of the mission and again on mission day 54, 55, or 56.

- Obtain crew body samples from the throat, nasal passage, auditory canal and between the large and fourth toe of each foot to detect the presence and conditions of microbial growth.

FO 3) Obtain in-flight microbiological samples from the crew 14 to 16 days prior to the end of the mission.

- Obtain data for determination of the presence and conditions of micro-organisms in the SWS atmosphere.

FO 4) Obtain in-flight microbiological samples of the SWS atmosphere on mission day 55 or 56.

Performance Requirements

a) Baseline Requirement

FO 1) A total of 30 hardware samples will be obtained consisting of one
FO 2) from each of 15 locations taken 14 to 16 days prior to the end of the mission and again on mission day 54, 55, or 56.

FO 3) A total of 12 crew body samples (4 samples per crewman) will be taken 14 to 16 days prior to the end of the mission.

FO 4) A total of 2 atmospheric samples consisting of 3 separate volumes each will be taken on mission day 55 or 56.

b) Minimum Scheduling Requirement

FO 1) Same as the baseline requirement
thru
FO 4)

c) Performance Redline

FO 1) Not applicable
thru
FO 4)

Performance Conditions

- FO 1) Fifteen in-flight microbiological hardware samples will be obtained
 FO 2) 14 to 16 days prior to the end of the mission (FO 1) and again on mission day 54, 55, or 56 (FO 2).

The microbiological hardware samples will be obtained shortly after high crew activity periods on the days specified.

Each hardware sample will be obtained by swabbing a 2-inch by 2-inch area at the marked sites in the following locations:

- 1) MDA - ECS branching duct between stations 3522.503 and 3566.964 below the -X direction cable tray cover
- 2) Panel 205 AM - Structural Transition Section
- 3) Forward dome; hatch cover
- 4) OWS wall behind film vault
- 5) Experiment compartment outer wall (panel 614)
- 6) Sleep compartment entry (intra-grid to the left side of entry)
- 7) Experiment compartment wall (within grid above light switch panel 630)
- 8) Waste management compartment; odor control debris screen
- 9) Waste management compartment; fecal and urine collection subsystems blower compartment door
- 10) Waste management compartment; exterior of waste processor drawer 3
- 11) Waste management compartment; handrail in +X direction
- 12) Wardroom; surface between panels 760 and 763
- 13) Top of one wardroom food tray (below heat and time advisory module)
- 14) Top surface of trash disposal airlock
- 15) M092 LBNP device (to the left and right of switch)

Sites 5, 9 and 15 may be substituted with contingency sampling sites with the appropriate transport tube label change to identify such contingency site.

- FO 3) Four body samples from each crewman will be obtained 14 to 16 days prior to the end of the mission.

The microbiological crew sample will be obtained by swab shortly after crew sleep periods, and prior to personal hygiene or eating.

The four body samples from each crewman will be taken using a single swab at each of the following sites:

- 1) Throat (pharyngeal vault and tonsillar area)
- 2) Each nasal passage

- 3) Each auditory canal
- 4) Between the large and fourth toe of each foot

Site 4 may be substituted with a contingency sample, if any, with the appropriate transport tube label change to identify such contingency site.

- FO 4) Two in-flight microbiological SWS atmosphere samples will be obtained on mission day 55 or 56 at each of the following sites:
- 1) OWS - beside trash airlock 3 to 4 feet above the deck
 - 2) AM station 0.00 (AM/OWS hatch)

Each sample will consist of separate volumes of SWS atmosphere. Ten, five, and one minute(s) of atmosphere collection operations will be performed at each site using a separate plate for each volume.

- FO 1) The microbiology sample swabs will be placed into Transport Media thru Tubes, the handles broken, and the caps replaced on the tubes for
FO 3) return.
- FO 1) The in-flight microbiology samples at the close of the mission thru will be stored in the chiller and placed in the Command Module
FO 4) Resupply and Return System of the In-Flight Medical Support System (IMSS) and returned to the ground.

In-Flight Data

- a) Telemetry - None
- b) Crew Voice Comments - Comments relative to the operation and conduct of the experiment are to be recorded for subsequent dump.
- c) Log Books - None
- d) Photographs - None
- e) Return Payload - Return system of the IMSS.

For additional details, refer to Appendix A.

Evaluation

The returned samples will be analyzed to assess the overall habitability of the SWS, to provide a retrospective analysis of any microbiological problems with the crew or hardware, and to develop measures for prevention or control of potential crew illnesses on return visits.

Initial processing of samples will be performed on the recovery vessel. The samples will be returned to the Johnson Space Center for identification and quantitation of the micro-organisms present. Technical reports will be made available as appropriate.

OPERATIONAL RADIATION MEASUREMENTS

Obtain external and internal Orbital Assembly radiation data.

Purpose and Background

The purpose is to obtain radiation data during the Skylab mission unmaned and manned periods to determine that the accrued or projected flight crew radiation exposure is within the defined operational dose limits. The data to be obtained by use of the Personal Radiation Dosimeters (PRD's), Van Allen Belt Dosimeter (VABD), Radiation Survey Meter (RSM), and Electron Proton Spectrometer (EPS) in support of FO 1 thru FO 56 are mandatory for proper assessment of crew safety. The VABD data during the unmaned period (FO 57) will confirm that there has been no significant change in the radiation environment prior to the manned period. The crew radiation dose and dose equivalent data as integrated by the Crew Passive Dosimeters (CPD's) in FO 58 are required for medical records and will be used to demonstrate compliance with radiation protection limits established for space flights.

Additionally, the purpose of FO 59 is to measure the radiation environment inside the drawers of the Orbital Workshop (OWS) film vault. The data from SL-3 mission will be used to verify theoretically predicted values of radiation exposure of the films during this mission as a basis for change decisions with respect to film on the SL-4 mission. The conduct of FO 59 is not mandatory for crew safety or for the accomplishment of mission objectives.

Functional Objectives

- Obtain data to determine any changes in the radiation environment.
- FO 1) Obtain data for these FO's in accordance with the 20.11 Table
thru of Baseline Requirements.
FO 3),
FO 5)
thru
FO 28),
FO 30)
thru
FO 53),
and
FO 55)
thru
FO 57)
- Obtain data to determine the radiation dose during EVA.
- FO 4), Obtain VABD and CSM EPS data continuously during EVA. Obtain
FO 29), PRD readings just prior to and just after EVA from all three
and PRD's. Monitor the RSM radiation dose rate data during EVA.
FO 54)

- Measure the individual integrated flight crew radiation dose (rad) and obtain data to allow determination of dose equivalent (rem).

FO 58) Wear and return one CPD per crewman which has been worn continuously throughout the mission.

- Determine the cumulative radiation dose for missions SL-2 and SL-3 inside the film vault of the OWS forward compartment.

FO 59) Obtain radiation data from the film vault by use of two CPD's.

Performance Requirements

a) Baseline Requirement

FO 1) The baseline requirement is shown in the following 20.11 Table
thru of Baseline Requirements.

FO 59)

b) Minimum Scheduling Requirement

FO 1) Same as the baseline requirement
thru

FO 58)

FO 59) None

c) Performance Redline

FO 1) Not applicable
thru

FO 58)

FO 59) Any one CPD from the film vault will be useful.

Performance Conditions

FO 1) The South Atlantic Anomaly (SAA) may be generally described as
thru an elliptical area extending from the equator to approximately
FO 56) 65°S latitude and from 80°W longitude to 50°E longitude. For
the purpose of this DTO, the SAA boundary is defined by isoflux
contour lines of 10 electrons/cm²-sec with energy equal to or
greater than 0.5 Mev as shown in the attached figure.

The Horns of the outer Van Allen Belts extend down to Skylab orbital altitudes at latitudes 45°N and 45°S. The OA will encounter these Horns of the Van Allen Belt at the northernmost portion of the orbit between 35°W and 120°W longitude and at the southernmost portion of the orbit between 35°E and 180°E longitude. For the purpose of this DTO, the boundary of the Horns is defined by isoflux contour lines of 10 electrons/cm²-sec with energy equal to or greater than 0.5 Mev as shown in the attached figure.

FO 1) VABD and CSM EPS data will be obtained for the five passes through the SAA and outer Van Allen Belt Horns which yield maximum radiation during the first mission day.

20.11
Table of Baseline Requirements

FO No.	Mission Day	VABD Data		EPS Data		PRD Data	RSM Data
		SAA	Horns	SAA	Horns		
1	1	5 passes	5 passes	All passes	All passes	1 reading per crewman	Three 1-minute readings adjacent to VABD while in a maximum SAA pass prior to mission day 4
2	2	2 passes	2 passes	2 passes	2 passes	1 reading per crewman	
3	3	2 passes	2 passes	2 passes	2 passes	1 reading per crewman	
4	4	Continuous data during EVA (to include time period outside of SAA and Horns)		Continuous data during EVA (to include time period outside of SAA and Horns)		1 reading before and after EVA for each of 3 PRD's	Monitor to verify compliance with mission rules
5 thru 26	5 thru 26	1 pass daily thru SAA or Horns		1 pass daily thru SAA or Horns		1 reading daily for each of 3 locations	None
27	27	2 passes	2 passes	2 passes	2 passes	1 reading for each of 3 locations	None
28	28	2 passes	2 passes	2 passes	2 passes	1 reading for each of 3 locations	None

20.11
Table of Baseline Requirements (Continued)

FO No.	Mission Day	VABD Data		EPS Data		PRD Data	RSM Data
		SAA	Horns	SAA	Horns		
29	29	Continuous data during EVA (to include time period outside of SAA and Horns)		Continuous data during EVA (to include time period outside of SAA and Horns)		1 reading before and after EVA for each of 3 PRD's	Monitor to verify compliance with mission rules
30 thru 51	30 thru 51	1 pass daily thru SAA or Horns		1 pass daily thru SAA or Horns		1 reading daily for each of 3 locations	None
52	52	2 passes	2 passes	2 passes	2 passes	1 reading for each of 3 locations	None
53	53	2 passes	2 passes	2 passes	2 passes	1 reading for each of 3 locations	None
54	54	Continuous data during EVA (to include time period outside of SAA and Horns)		Continuous data during EVA (to include time period outside of SAA and Horns)		1 reading before and after EVA for each of 3 PRD's	Monitor to verify compliance with mission rules
55	55	1 pass thru SAA or Horns		1 pass thru SAA or Horns		1 reading for each of 3 locations	None
56	56	1 pass thru SAA or Horns		1 pass thru SAA or Horns		1 reading for each of 3 locations	None

20.11
Table of Baseline Requirements (Continued)

FO No.	Mission Day	VABD Data		Crew CPD's	Film Vault CPD's
		SAA	Horns		
57	-60	1 pass daily for each of these 15 days prior to the manned portion of SL-3	1 pass daily for each of these 15 days prior to the manned portion of SL-3	N/A	N/A
	-55				
	-50				
	-45				
	-40				
	-35				
	-30				
	-25				
	-20				
	-15				
	-10				
	-5				
	-3				
	-2				
	-1				
58	1 thru 56	N/A	N/A	1 CPD per crewman will be worn continuously	N/A
59	-60 thru 56	N/A	N/A	N/A	Two CPD's located continuously in OWS film vault (one each in drawers B and F)

- FO 2) VABD and CSM EPS data will be obtained for the two passes per
FO 3) day through the SAA and outer Van Allen Belt Horns which yield
FO 27) maximum radiation for each of the two days preceeding each of
FO 28) the three EVA's (i.e., mission days 2, 3, 27, 28, 52, and 53 -
FO 52) presuming that EVA occurs on mission days 4, 29 and 54).
FO 53)
- FO 4) VABD and CSM EPS data are required for the entire time period
FO 29) of all three EVA's (i.e., mission days 4, 29 and 54).
FO 54)
- FO 5) VABD and CSM EPS data are required only on one pass daily through
thru either the SAA or Horns for the remaining mission days (i.e., days
FO 26), 5 thru 26, 30 thru 51, 55 and 56).
FO 30)
thru
FO 51),
FO 55)
FO 56)
- FO 1) PRD's will be worn during crew activities the first three mission
thru days and PRD data will be voice logged for each crewman during
FO 3) these days. Specific PRD's will be assigned to individual crewmen.
- FO 5) During mission days 5 thru 28 and 30 thru 53, PRD data will be
thru voice logged once every 24 hours from PRD's stowed at three
FO 28), locations. One PRD will be located in the sleep area, the second
FO 30) PRD will be in the OWS experiment compartment and the third PRD
thru will be in one of the two scientific airlock locations for these
FO 53), two days. On days 55 and 56 the PRD's may be located in the
FO 55) Pressure Garment Assemblies (provided they are readily accessible)
FO 56) but the PRD's will be read daily for these two days.
- FO 4) On mission day 4 (day of the first EVA), the PRD's will be worn
FO 29) by all three crewmen. One reading will be obtained from each of
FO 24) the crewmen before EVA and again after EVA. The PRD readings
before EVA will be taken after the last SAA pass prior to EVA.
The PRD readings after EVA will be taken prior to the next SAA
pass that follows EVA. This same usage of three PRD's will be
followed on mission days 29 and 54 (i.e., the next two days of
EVA).
- FO 1) A spare PRD, stowed in the CM in locker B-1, will be available
thru for use but there is no requirement to make periodic readings
FO 56) of this instrument so long as it remains as a spare unit. All
four PRD's will be returned to earth for postflight calibration.
- FO 1) For a solar flare of corrected area of at least 15 square degrees
thru or a 10-centimeter RF burst of greater than 500 flux units
FO 56) above background, as reported by the National Oceanic and
Atmospheric Administration (NOAA), additional data will be re-
quired from the Orbital Assembly (OA) and other orbital satel-
lites. The OA data will include VABD, CSM EPS, and PRD data
to be obtained as required based on the degree and rate of
radiation environment enhancement. The satellite data will be

obtained from satellites such as Explorer satellites (IMP-H and IMP-I), VELA satellites, DSP satellites, ATS-1, TIROS, SOLRAD 9 and SOLRAD 10.

- FO 1) At least three 1-minute readings using the Radiation Survey
thru Meter (RSM) at the VABD area, will be made and voice logged
FO 3) anytime prior to mission day 4 (day of EVA). The survey of
this location will be made on a SAA pass that encounters maximum
proton intensity. Each time the RSM is used, it will be pointed
at the closest unencumbered exterior wall of the spacecraft with
the RSM axis parallel to the floor. The RSM reading and time
will be logged at one-minute intervals during each of the three-
minute periods. In addition, the crew will identify the
pointing direction of the RSM by voice log for each reading.
- FO 4) On mission days 4, 29 and 54, the RSM will be removed from its
FO 29) bracket, placed on a meter range to be determined in real time
FO 54) by MCC-H, and located where observable by the non-EVA crewman
for each of the three EVA's. Radiation dose rate will be
monitored to verify compliance with the mission rules for
radiation exposure during EVA.
- FO 1) When not in use, the RSM will be stowed in the RSM bracket,
thru operating on the 1.0 rad/hour range when stowed.
FO 3),
FO 5)
thru
FO 28),
FO 30)
thru
FO 53)
- FO 1) Radiation data from any artificial event will be provided through
thru NASA Headquarters. VABD, CSM EPS, PRD and RSM data in addition
FO 56) to that normally scheduled will be obtained as necessary to
define the radiation environment enhancement. Ground-based
riometer data will be obtained from the Guam tracking station.
- FO 57) VABD data will be obtained during the unmanned portion of
mission SL-3 to determine any changes in the radiation environ-
ment since the completion of mission SL-2.
- These VABD data will be obtained once every five days from 60
to five days prior to the launch of SL-3. Data will also be
obtained daily during the last three days prior to launch. The
data will be obtained during passes through the SAA and the
Horns.
- FO 58) Each crewman will wear a CPD continuously during the entire
mission. These CPD's will be returned to earth for analysis.
- FO 59) Two CPD's (one each in drawers B and F) will be installed in
the film vault drawers as soon as possible following the OWS
film vault activation during mission SL-2. These two CPD's will
accumulate data during missions SL-2 and SL-3. They will be

removed from the film vault drawers as close as possible to the end of mission SL-3 and stowed in the CM for return to earth.

In-Flight Data

- a) Telemetry - VABD and CSM EPS data will be transmitted in real-time and/or playback mode.
- b) Crew Voice Comments - The PRD and RSM readings will be voice logged for real-time transmission or playback.
- c) Log Books - None
- d) Photographs - None
- e) Return Payload - Five CPD's (one per crewman and one from each of two film vault drawers) and four PRD's

For additional details, refer to Appendix A.

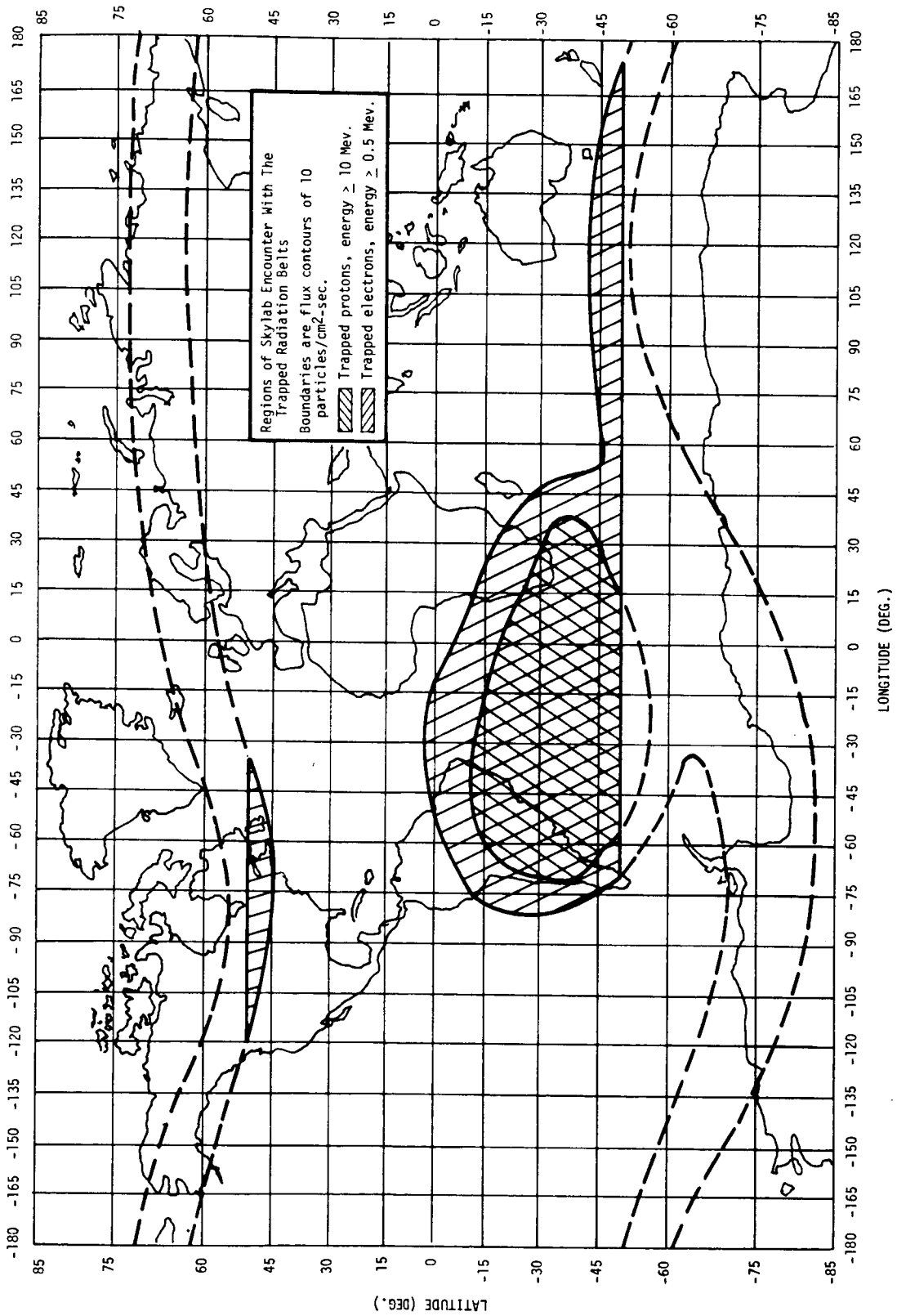
Evaluation

Levels of radiation will be reviewed in near real time throughout the mission for FO 1 thru FO 57 to determine changes and to provide assessment of hazard to crew health should enhancement of radiation occur. Existing and projected radiation doses will be assessed prior to the GO/NO GO decisions for launch and for each EVA.

Crew passive dosimeters will be analyzed postflight for FO 58 to determine the time integrated dose contribution from high atomic number particles, neutrons, protons, electrons and other radiations to which the crew members have been exposed.

The film vault dose will be evaluated for FO 59 immediately postflight to assist in determining the radiation dose to the photographic film and consequent background fogging.

Trapped Radiation Environment Boundary for Skylab



Obtain optical contamination data on the Orbital Assembly (OA)

Purpose and Background

The purpose is to obtain data to support OA contamination assessment and evaluation during the SL-3 mission period.

A history of instrument and equipment failure, as a result of contamination, has evolved during the space program prior to Skylab. Due to the increased complexity of Skylab systems, manned operations, and the extended mission durations, there is reason to believe that the spacecraft may experience the most severe contamination environment of any spacecraft up to its time. Many control measures have been adopted in the Skylab program to reduce these contamination effects. It is of considerable importance to determine the effectiveness of these measures and to obtain data for the prediction of contamination effects to enable the optimum usage of experiments. Information from SL-3 can be used for Skylab mission planning purposes, for the development of operational and design criteria for future manned spacecraft, and as an empirical data source to aid in the development of future contamination analyses techniques. In order to accomplish the evaluation and assessment of the contamination, it is necessary that Skylab crewmen observe and describe visible vent plumes and contamination deposition on windows and various experiment optical surfaces. Photographs are required of any observed contamination on the windows and they are desired for the visible vent plumes. It is also desirable that the crew describe and photograph significant contamination deposition on external surfaces and solar array assemblies.

The conduct of this DTO is not mandatory for crew safety or for accomplishment of mission objectives. A determination of whether to schedule this DTO will be made in real time depending on SL-1/SL-2 contamination data evaluation and/or real-time SL-3 contamination experience.

Functional Objectives

● Obtain data on the contamination effects of certain OA vent plumes and how these vent plumes and associated contamination change with the duration of the mission.

- F0 1) Observe, photograph, and comment on the characteristics of certain OWS vent plumes early in the mission.
- F0 2) Observe and comment on the characteristics of certain OWS vent plumes during midmission.
- F0 3) Observe, photograph, and comment on the characteristics of certain OWS vent plumes late in the mission.
- F0 4) Observe, photograph, and comment on the characteristics of certain OA vent plumes as they occur during the mission.

● Obtain data concerning the contamination on certain OA windows and how this contamination changes with the duration of the mission.

- FO 5) Observe, photograph, and comment on the characteristics of window contaminants early in the mission.
- FO 6) Observe and comment on the characteristics of window contaminants during midmission.
- FO 7) Observe, photograph, and comment on the characteristics of window contaminants late in the mission.
- FO 8) Observe and comment on the characteristics of window contaminants during normal viewing times.

● Obtain data concerning contaminants deposited on experiment optical surfaces during the mission.

- FO 9) Observe and comment on the characteristics of contaminants on experiment optical surfaces as the experiments are used during the mission.

● Obtain data concerning OWS vent plumes and contaminants deposited on certain OA external surfaces as viewed during EVA.

- FO 10) Observe and comment on OWS vent plumes and contaminants on external surfaces during EVA.

Performance Requirements

a) Baseline Requirement

- FO 1) The baseline requirements are described in the Table of Baseline thru Requirements.
- FO 10)

b) Minimum Scheduling Requirement

- FO 1) None
- thru
- FO 10)

c) Performance Redline

- FO 1) Not applicable
- thru
- FO 10)

Performance Conditions

- FO 1) If contamination of windows and experiment optics is not thru observed and if vent plumes are not observed negative reporting
- FO 10) is acceptable, i.e., no comments or photographs are required.

- FO 1) The OWS waste tank vent plume will be observed for visible
- FO 3) particles during a dump early (FO 1) (within first eight days) and late (FO 3) (within the last seven days) in the mission.

Observations should begin approximately 5 minutes after the squeezer bag dump initiation and should last for approximately 20 seconds.

If the squeezer bag dump plume is visible, it is mandatory that a photograph be obtained on a subsequent squeezer bag dump.

Photographs may be obtained of the dump following the observation which revealed a visible vent.

It is desirable to observe the OWS waste tank vent plume during waterline flush and drain operations at the beginning (FO 1) and end (FO 3) of the mission.

Observations of the flush and drain operations should begin approximately 10 minutes after the start of such operation and last for approximately 20 seconds.

FO 2) It is desirable to observe the OWS waste tank vent plume during a squeezer bag dump for the midmission period.

Observations should begin approximately 5 minutes after a squeezer bag dump initiation and last for approximately 20 seconds.

FO 1) It is desirable to observe the OWS waste tank vent plume during
FO 2) an ECS condensate dump when performed.
FO 3)

Observations should begin approximately 10 minutes or later after ECS condensate dump initiation and last for approximately 20 seconds.

All observations should be made from the wardroom window.

Each time the following prime mode free water dumps to the OWS waste tank occur, the event time will be voice recorded for relay to earth.

- a) Condensate - Initiating time within 3 to 5 minutes accuracy
- b) Squeezer bag - Initiating time within 3 to 5 minutes accuracy
- c) Waterline flush and drain (beginning and end of mission) - Initiating times within 3 to 5 minutes accuracy

FO 4) The molecular sieve vent operation will be observed for visible particles at least once from the STS viewport (located between the +Z and -Y axes).

The molecular sieve vent observation should begin at the onset of the venting and continue for approximately 2 minutes.

If the molecular sieve vent plume is visible, it is mandatory that a photograph be obtained during a subsequent vent cycle.

If the following contingency mode dumps are used, the initiation times will be voice recorded.

- a) Condensate (overboard from AM) - Initiating time and terminating time within 1 minute accuracy
- b) Urine (free liquid into OWS waste tank) - Initiating time within 3 to 5 minutes accuracy

- c)* Urine (overboard from CSM) - Initiating time and terminating time within 1 minute accuracy
- d)* Waste water (overboard from CSM) - Initiating time and terminating time within 1 minute accuracy

FO 1) With respect to the comments required during vent observation,
thru the general appearance, angular spread, and approximate length
FO 4) of all visible plumes and the random motions of individual
particles relative to the plume axis are the types of things
that should be described. The comments will be voice recorded
during the viewing period.

Observations and photographs should be made during orbital day-
light with the dark sky forming a background for the plume.

All light sources which reflect on the window from which
observations and photographs are being made should be extinguished
if possible.

All exterior OA light sources within the field-of-view should be
extinguished.

FO 1) When making observations from the wardroom window, the T002 hood
FO 2) can be used to minimize undesirable interior light sources.
FO 3)

FO 5) The wardroom window will be observed for contamination deposi-
FO 6) tion trends during early, middle, and late mission periods.

FO 7) The STS viewports between the +Z and +Y axes and the -Z and +Y
axes will be inspected during normal viewing periods during
early, middle, and late mission periods.

FO 8) It is desirable to observe the following windows for contamina-
tion during normal viewing times:

- a) -Y +Z and -Z -Y STS viewports
- b) EVA hatch window
- c) CSM windows

FO 5) The general appearance and location of any contamination,
thru including the particular pane surface(s) upon which it is
FO 8) located, will be voice recorded.

The typical kinds of contamination which may be observed will
generally fall into four broad categories: (1) particulates,
(2) scratches, (3) thin deposition films and (4) thick films
or smudges. Particulates may be described by their quantity,
estimated size, shape, and location. Scratches may be described
by length, number of scratches per inch, estimated area covered
by the scratches and orientation of the scratches. Thin deposi-
tion films may typically be described by the total area covered,

* The times for these dumps are required only when the CSM is docked or
within 1,000 feet of the OA.

by a description of the shape of the deposit, and by the coloration or diffraction effects of the film. These films may create a diffraction pattern on an optical surface or may show a uniform iridescent coloring of itself. Smudges are the most general class and thus the most difficult to describe. The density of the smudge and the area covered are the only specific parameters that can be described. It would be helpful if the source of the smudge can be identified; e.g., finger print, residue from attempted cleaning.

If contamination deposition is observed on the wardroom window, or the +Z +Y, -Z +Y STS viewports, it will be photographed during the early and late portions of the mission.

It is desired to obtain additional photographs at the discretion of the crew based on the required observation.

The windows should be illuminated by the sun or by reflections from moon or earth but the light source should not be within the field-of-view.

It is desirable that the same light source be used for all observations and photographs.

The OA interior should be as dark as possible consistent with other experiment operations.

All OA light sources which reflect on the window from which observation and photographs are being made should be extinguished if possible.

All exterior OA light sources within the field-of-view should be extinguished.

FO 5) When making observations from the wardroom window, the T002 hood
FO 6) can be used to minimize undesirable interior light sources.
FO 7)

FO 9) Inspection will be made of the S190B experiment SAL window and the S190B camera lens for contamination deposits.

Inspection will be made of the S063 SAL window for contamination deposits.

Inspection will be made of the T002 optical surfaces for contamination deposits.

All surface contamination noted during the above inspections will be voice recorded by the crewman.

If the following experiment optical surfaces are cleaned, observations will be made on the nature of contamination on the surfaces.

- a) S019 Mirror
- b) S190A
 - 1) Platens
 - 2) Front lenses (front surfaces)
 - 3) Filters (both surfaces)
 - 4) MDA window (inside surface)

- c) S190B
 - 1) Experiment SAL window
 - 2) Camera lens
- d) S192
 - 1) Thermal imaging lens
 - 2) Dewar thermal window
 - 3) Monochromatic imaging lens
 - 4) Dewar monochromatic window
- e) M512
 - 1) View port
 - 2) View mirror
- f) S063
 - 1) Window
 - 2) Camera lens
 - 3) Filters
- g) T002
 - 1) Sextant and stadimeter lenses
 - 2) Neutral density filter

All surface contamination noted during the above observations will be voice recorded by a crewman.

The typical kinds of contamination which may be observed will generally fall into four broad categories: (1) particulates, (2) scratches, (3) thin deposition films, and (4) thick films or smudges. Particulates may be described by their quantity, estimated size, shape, and location. Scratches may be described by length, number of scratches per inch, estimated area covered by the scratches and orientation of the scratches. Thin deposition films may typically be described by the total area covered, by a description of the shape of the deposit, and by the coloration or diffraction effects of the film. These films may create a diffraction pattern on an optical surface or may show a uniform iridescent coloring of itself. Smudges are the most general class and thus the most difficult to describe. The density of the smudge and the area covered are the only specific parameters that can be described. It will be helpful if the source of the smudge can be identified; e.g., finger print, residue from attempted cleaning.

- FO 10) It is desirable that observations be made (during normally scheduled EVA) of external surfaces, to include the solar array assemblies, and emission from the OWS waste tank vent within the field-of-view of an EVA crewman.

Description of any vent emission and any contaminant on external surfaces as observed during EVA should be voice recorded.

In-Flight Data

- a) Telemetry - None
- b) Crew Voice Comments - Description of vent plumes, window contamination, experiment optical surface contamination, times of vents or dumps, and contamination observed during EVA, will be voice recorded for playback.
- c) Log Books - None
- d) Photographs - Photographs of vent plumes, window contamination.
- e) Return Payload - To be included as a part of the operational film.

For additional details, refer to Appendix A.

Evaluation

Recorded observations and photographs will be studied and evaluated for indications of possible degradation of various surfaces due to contaminant deposition and for the characteristics of exhaust plumes from various venting operations. Results will be used for mission support to determine possible need for modification to Skylab mission planning, corrections to some optical experiment data and for design inputs to control contamination in future manned spacecraft.

20.14 Table of Baseline Requirements

Subject	FO	One (1) Observation/Photo (Photo only if visible) during mission interval			Observation: when normally in vicinity or during experiment performance.	Voice Negative reporting is acceptable. Voice reporting is required only when a mandatory vent is initiated or contamination is observed.	Description of Observation
		Early	Mid	Late	Anytime	Vent Initiation Time	
OWS Waste Tank Vent							
1) Squeezer Bag dump	1, 2, 3	0,P	0	0,P		T	D
2) Water line flush and drain	1, 3	0		0		T	D
3) ECS Condensate	4			0		T	D
Contingency Dumps							
4) Condensate (from AM)	4					T	
5) Urine (OWS)	4					T	
6) Urine (CSM)	4					T	
7) Waste Water (CSM)	4					T	
8) Molecular sieve vent	4			0,P			D
Windows							
9) Wardroom	5, 6, 7	0,P	0	0,P			D
10) STS (+Z,+Y and -Z,+Y)	5, 6, 7	0,P	0	0,P			D
11) STS (-Y,+Z and -Z,-Y)	8				0		D
12) EVA Hatch	8				0		D
13) CSM	8				0		D
Experiment Optical Surfaces							
**** as used ****							
14) S190 Window	9				0		D
15) Camera lens	9				0		D
16) S063 Window	9				0		D
17) T002 Optical Surfaces	9				0		D
**** if cleaned ****							
18) S019 Mirror	9				0		D
19) S190A Platens	9				0		D
Front lenses	9				0		D
Filters	9				0		D
MDA Window	9				0		D
20) S192 Thermal Imaging Lens	9				0		D
Dewar thermal window	9				0		D
Monochromatic imaging lens	9				0		D
Dewar monochromatic window	9				0		D
21) S1908 Window	9				0		D
Camera lens	9				0		D
22) M512 View port and	9				0		D
View mirror	9				0		D
23) S063 Window	9				0		D
Camera	9				0		D
Filters	9				0		D
24) T002 Sextant and Stadimeter lenses	9				0		D
Neutral density filter	9				0		D
25) Any deposition (during EVA)	10				0		D
26) Any vent emissions (during EVA)	10				0		D

KEY: 0 - Observe; P - Photograph; T - Voice Record Time; D - Describe

Obtain an in-flight water sample

Purpose and Background

The purpose is to collect an in-flight water sample to verify the chemical quality of the water.

There is need to determine the level of the chemical constituents of the water to (1) verify that metal ion specification levels are not exceeded and (2) determine the metallic ion content of the particulate matter suspended in the ion exchange bed product water.

The conduct of this DTO is not mandatory for proper assessment of crew safety but is mandatory in order that an assessment can be made of the impact of the potable water constituents in Experiments M071 (Mineral Balance) and M073 (Bioassay of Body Fluids).

Functional Objectives

- Obtain an in-flight potable water sample to verify the chemical quality of the water.

FO 1) Obtain an 8-ounce sample of water from the food pedestal water dispenser.

Performance Requirements

a) Baseline Requirement

FO 1) Collect one 8-ounce sample of water from the food pedestal water dispenser.

b) Minimum Scheduling Requirement

FO 1) Not applicable

c) Performance Redline

FO 1) Not applicable

Performance Conditions

FO 1) Collect a water sample during approximately the last week of the mission.

In-Flight Data

- a) Telemetry - None
 - b) Crew Voice Comments - None
 - c) Log Books - None
 - d) Photographs - None
 - e) Return Payload - An 8-ounce water sample
- For additional details, refer to Appendix A.

Evaluation

The water sample will be chemically analyzed to determine the constituents defined in Potable Water Specification PF Spec 1-D. These data will be provided to the Principal Investigators for M071 and M073 so that compensations may be made for any potential effects of water constituents. These data will also be used to verify the continuing acceptability of the potable water supply.

20.17

IODINE MONITORING

Maintain the desired iodine concentration in potable water tanks for this and the subsequent mission.

Purpose and Background

The purposes are to obtain in-flight data on iodine concentrations in the Orbital Workshop (OWS) potable water system and inject iodine, if necessary, to maintain biocidal activity for assurance of continuing water potability.

The conduct of this DTO is mandatory in order to assure the prevention of growth of microorganisms in the potable water, and to protect crew health.

Functional Objectives

- Verify iodine concentration in the potable water system and inject iodine, if necessary, to maintain biocidal action.

- FO 1) During Orbital Assembly (OA) activation, determine the iodine concentration in the wardroom water supply tank scheduled for immediate use.
- FO 2) During OA activation (FO 2) and on mission days 14(+3) (FO 3), thru 28(+3) (FO 4), and 42(+3) (FO 5), determine the iodine concentration in the water from the water chiller sample port.
- FO 5)
- FO 6) Determine the iodine concentration in a minimum of two untapped wardroom water supply tanks.

Performance Requirements

- a) Baseline Requirement
 - FO 1) During OA activation, the iodine concentration will be determined in the water from the wardroom water supply tank scheduled for immediate use.
 - FO 2) During OA activation, the iodine concentration will be determined in the water from the water chiller sample port.
 - FO 3) On mission days 14(+3) (FO 3), 28(+3) (FO 4), and 42(+3) (FO 5), thru the iodine concentration will be determined in the water from the water chiller sample port.
 - FO 5)
 - FO 6) Any time during the mission, the iodine concentration will be determined from at least two untapped wardroom water supply tanks.
- b) Minimum Scheduling Requirement
 - FO 1) Same as the baseline requirement
 - thru
 - FO 6)
- c) Performance Redline
 - FO 1) Not applicable
 - thru
 - FO 6)

Performance Conditions

- FO 1) If the iodine concentration in the wardroom water supply tank during activation is less than four ppm, iodine will be injected into the tank to achieve a concentration of up to six ppm. If the iodine concentration in the water tank is less than one ppm, then water from this tank should not be used for drinking purposes at this time. A real-time decision will be made concerning future use of this tank.
- FO 2) If the iodine concentration in the water from the water chiller
thru sample port is less than one ppm, then the iodine concentration
FO 5) must be determined in the wardroom water tank in use and iodine added to result in an iodine residual up to six ppm.
- FO 6) When the iodine concentration in at least two untapped tanks is determined, a real-time decision will be made regarding the requirement to inject iodine into any or all of the untapped water tanks. The decision will be based on projected iodine depletion rates, with the rate determined after acquisition of these data. As a tentative guideline, untapped water tanks intended for use during the SL-4 mission should be brought to an iodine concentration of at least six ppm.
- FO 1) The measuring of iodine concentrations and the injection of
thru iodine, when required, will be in accordance with procedures in
FO 6) the appropriate checklist.

Crew comments will be voice logged regarding all iodine concentration determinations and all additions of iodine to the water tanks.

In-Flight Data

- a) Telemetry - None
- b) Crew Voice Comments - Voice comments will be required in the following:
 - 1) Iodine concentration in the wardroom water tank sampled during OA activation and the amount of iodine injected into this tank at this time
 - 2) Iodine concentration in the water from the water chiller sample port as determined during OA activation and during mission days 14(+3), 28(+3), and 42(+3) [Note: If the iodine concentration in the water from this port at mission day 14(+3), 28(+3), or 42(+3) is less than one ppm, then the iodine concentration from the wardroom water supply tank in use will be reported. In addition, the amount of iodine required to raise the iodine concentration in the water supply tank to six ppm will be reported.]

3) Iodine concentration in at least two untapped wardroom water supply tanks (Note: If iodine is added to any of the untapped tanks, the iodine concentration prior to adding iodine will be reported. In addition, the amount of iodine added and the water tank numbers will be reported.)

- c) Log Books - None
- d) Photographs - None
- e) Return Payload - None

For additional details, see Appendix A.

Evaluation

Voice logged data for FO 1 thru FO 5 will be used in near real time by mission support personnel to determine that the iodine concentration is at the proper level to assure water potability throughout this mission. Voice logged data for FO 6 will be used in near real time by mission support personnel to insure that the iodine concentration in all remaining water tanks is maintained at the proper level to assure water potability during mission SL-4.

Obtain data on the carbon monoxide level in the Orbital Workshop experiment compartment.

Purpose and Background

The purpose is to determine whether there is a sufficient buildup of carbon monoxide (CO) in the cluster to interfere with the interpretation of medical experiment results or, in an extreme case, compromise crew safety.

Virtually all nonmetallic materials used in spacecraft construction and man, himself, produce small quantities of carbon monoxide. During an unmanned altitude test a slight, but definite, rise in CO was observed. It is not known whether the CO level will plateau, nor therefore, the concentration it may reach. A colorimetric method for determining CO concentrations is being provided for crew use to allow evaluation of the problem during flight.

The conduct of this DTO is mandatory for completion of the mission objectives and for crew safety.

Functional Objectives

- Obtain data on the level of CO in the OWS experiment compartment.

FO 1) Determine the CO level upon initial entry into the OWS experiment compartment.

Performance Requirements

a) Baseline Requirement

FO 1) The CO level will be determined as soon as feasible after the initial entry into the OWS experiment compartment.

b) Minimum Scheduling Requirement

FO 1) Same as the baseline requirement

c) Performance Redline

FO 1) Not applicable

Performance Conditions

FO 1) The procedure for determination of the CO level will be performed as described on the decal attached to the CO sampling apparatus.

The sample will be collected as soon as feasible after initial entry into the OWS experiment compartment. A real-time decision may be made to collect additional samples later in the mission if the data indicate a potential problem.

The results, in parts per million as approximated by color comparison, will be voice logged for each of the eight samples.

In-Flight Data

- a) Telemetry - None
- b) Crew Voice Comments - The CO level, in parts per million, will be voice logged.
- c) Log Books - None
- d) Photographs - None
- e) Return Payload - None

For additional details, refer to Appendix A.

Evaluation

The level of CO will be evaluated in near real time by the Toxicologist and by the Flight Surgeon. The data will also be provided to the Principal Investigators for Experiments M092 (In-Flight Lower Body Negative Pressure), M110 Series (Hematology and Immunology Series), and M171 (Metabolic Activity).

Observe the deployed SLA.

Purpose and Background

The purpose is to verify correct deployment of the Spacecraft/LM Adapter (SLA).

The SLA's for Skylab and the Apollo Soyuz Test Project (ASTP) are identical as regards the deployment mechanism (Block I). The only Block I SLA flown previously (on Apollo 7) failed to deploy correctly. Correct deployment of the SLA panels is critical to the ASTP mission to allow the Command and Service Module (CSM) to dock with and withdraw the docking module. Immediately after separation of the CSM from the S-IVB the CSM will be maneuvered to allow the crew to observe the SLA and assess its deployment. If the SLA panels do not deploy properly, photographs of the panels will be obtained.

The conduct of this experiment is not mandatory for crew safety or for the accomplishment of Skylab mission objectives. It is, however, very important that this DTO be accomplished to provide the desired data for ASTP.

Functional Objectives

- Observe the deployed SLA.

FO 1) Observe and comment on the deployment of the SLA panels.

Performance Requirements

a) Baseline Requirement

FO 1) Perform visual observations of the deployed SLA panels and make a verbal report.

b) Minimum Scheduling Requirement

FO 1) Same as the baseline requirement

c) Performance Redline

FO 1) None

Performance Condition

FO 1) The CSM will be maneuvered in pitch as soon as possible after CSM/S-IVB separation to allow crew observation of the SLA.

The crew will record voice comments on the estimated deployment angle of each SLA panel.

If it is determined that one or more of the SLA panels did not deploy properly, then the crew will photograph the deployed SLA panels using a Hasselblad 70-mm camera.

Translation maneuvers which perturbate the CSM state vector will not be made to enhance either visual or photographic observations.

In-Flight Data

- a) Telemetry - None
- b) Crew Voice Comments - Voice record and/or real-time voice comments of crew observations.
- c) Log Books - None (unless crew voice logging cannot be accomplished)
- d) Photographs - 70-mm photographs if required
- e) Return Payload - Log books (if voice logging was not accomplished) and photographs, if required. (Photographs required for this DTO will be charged to operational film payload).

For additional details, refer to Appendix A.

Evaluation

Data will be provided to the ASTP Program Office for evaluation.

REFERENCES

1. NASA Headquarters Program Directive No. 43C, M-D ML3200.125, dated May 1, 1973.
2. Cluster Requirements Specification No. RS003M00003, dated August 8, 1969.